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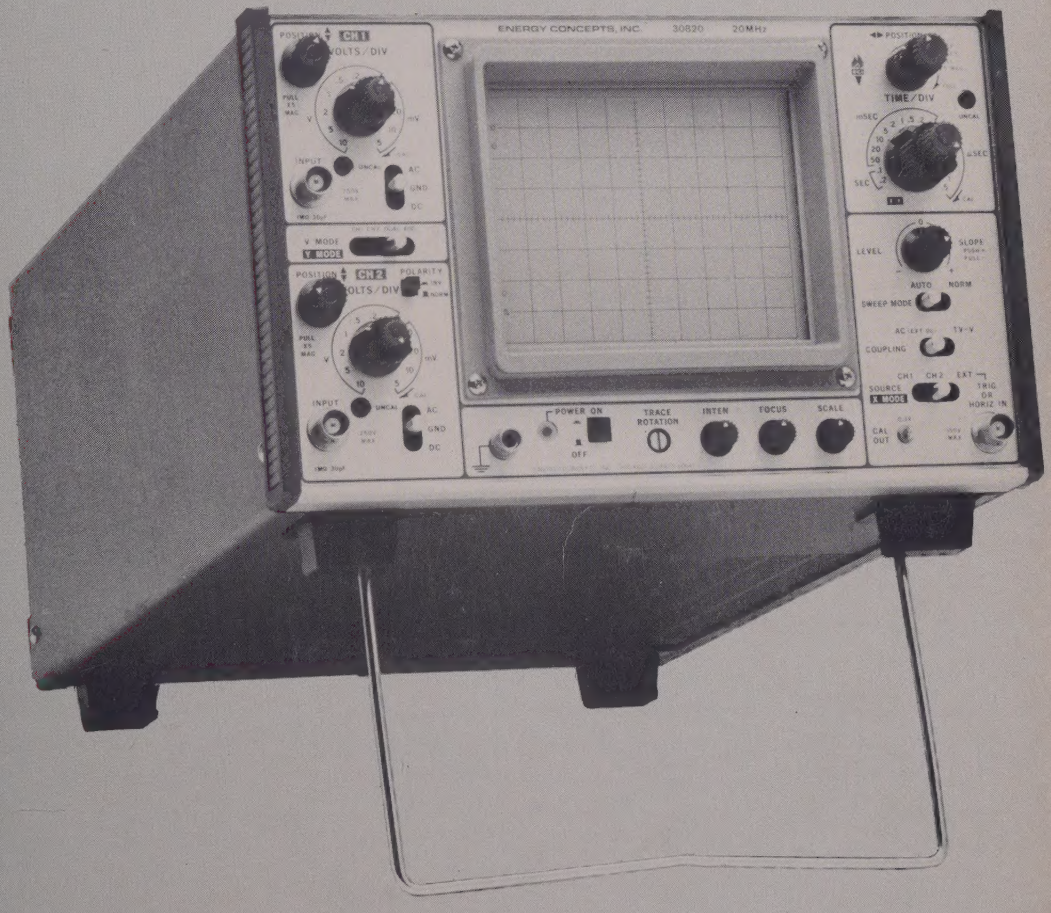
MAINTENANCE INFORMATION FOR THE

20 MHz DUAL TRACE OSCILLOSCOPE NO. 30820



ENERGY CONCEPTS, INC. ECi

INTRODUCTION

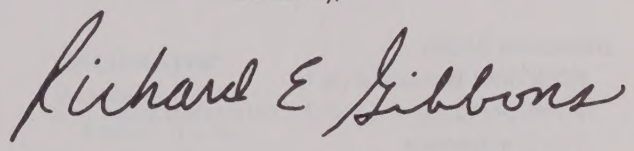
This manual provides maintenance information for the Energy Concepts 20 MHz DUAL TRACE OSCILLOSCOPE, Model No. 30820. Read this manual thoroughly before you use the unit. Additional information for the unit is also included in the *OPERATION INFORMATION FOR THE 20 MHz DUAL TRACE OSCILLOSCOPE,* manual number 30809.

Each new unit has been thoroughly inspected, adjusted, and tested before shipment from the factory. As soon as you receive the unit, inspect the shipping carton and the equipment for damage. Report any visible damage to your local carrier for repair or replacement. If the unit does not function properly, or if you have any questions, contact the Energy Concepts Service Center.

This instrument is backed by more than sixty years of experience in designing and manufacturing of educational and practical training equipment. Every effort has been made to design into each unit a maximum degree of dependability, accuracy, and durability. New products are being designed constantly to meet the needs of both education and the service industries. We welcome comments that you may have about our products or test equipment.

It is both a privilege and a pleasure to continue serving you.

Sincerely,



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Printed in the United States of America, 1984.

SPECIFICATIONS*

CATHODE-RAY TUBE (CRT)

Graticule
8 div X 10 div (1 div = 10 mm)
Internal graticule parallax free
Phosphor
B31 (standard)
P7, B11 (option)
Accelerating Potential
Approximately 2kV

VERTICAL DEFLECTION SYSTEM

Display Mode
Channel 1, Channel 2, Dual display of Channel 1 and Channel 2, Added display of Channel 1 and Channel 2 (In the dual mode, setting the sweep rate to a range lower than 1 mS/div allows chopped display and setting it to a range higher than 0.5 mS/div permits alternate display).
Chopped repetition rate: 100 kHz ± 50%

Deflection Factor
POSITION is pushed (X 1):
5 mV/div to 10 V/div in 11 calibrated steps in a 1-2-5 sequence
5 mV/div to 25 V/div continuously variable with control
Accuracy: ± 4% (10°C to 35°C)
POSITION is pulled (PULL X 5 GAIN):
1 mV/div, 2 mV/div
1 mV/div to 5 mV/div continuously variable with control
Red light indicates uncalibrated position
Accuracy: ± 5% (10°C to 35°C)
Frequency Response
DC to 20 MHz –3dB
(in center 6 divisions and ranges from 5 mS/div to 0.2 V/div. The AC-coupled lower –3dB frequency is 4 Hz or less.)
Rise Time
17.5 nS or less
Input Coupling
AC, GND, DC

Input RC
Direct: 1MΩ ± 3%//30pF ± 3pF
X 1 position of probe:
1MΩ ± 3%//170 pF ± 10pF
X 10 position of probe:
10MΩ ± 5%//23pf ± 3pF

Maximum Input Voltage
Direct: 250V (dc + peak ac)
X 1 position of probe:
250 V (dc + peak ac)
X 10 position of probe:
600V (dc + peak ac)
Polarity Inversion
Provided only for Channel 2

TRIGGERING

Source
Internal (CH1, CH2), External
Coupling
AC (internal only), DC (external only), TV-V
Slope
Positive-going, Negative-going
External Input RC
1MΩ ± 10%//30pF ± 5pF
External Maximum
Input Voltage
150V (dc + peak ac)
Sensitivity
Shown in Table 1 below

TABLE 1

Frequency range	Level	
	Internal (displayed amplitude)	External (input voltage)
DC to 20 Hz	–	0.5 V
20 Hz to 50 Hz	2.0 div	0.5 V
50 Hz to 5 MHz	0.5 div	0.5 V
5 MHz to 15 MHz	1.5 div	1.5 V
15 MHz to 20 MHz	2.0 div	2.0 V

Notes:
1. Signals below 20 Hz are attenuated in the internal triggering.
2. In the automatic sweep mode, the lower end of triggerable frequency is 50 Hz.
3. In the TV-V triggering, the trigger level is 1 division or more with displayed amplitude of sync signal portion of composite signal.

***SPECIFICATIONS AND DESCRIPTIONS SUBJECT TO CHANGE WITHOUT NOTICE**

HORIZONTAL DEFLECTION SYSTEM

Sweep Mode
Automatic, Triggered
Sweep Rate
0.5 μ S/div to 0.2S/div in 18 calibrated steps in a 1-2-5 sequence
0.5 μ S/div to 0.5S/div continuously variable with control
Accuracy I (over center 8 divisions):
(10°C to 35°C)
0.5 μ S/div to 5mS/div ± 4%
10 mS/div to 0.2S/div ± 5%
Accuracy II (over any 2 divisions within center 8 divisions):
±10% (10°C to 35°C)
Sweep Magnification
5 times
(Maximum sweep rate: 0.1 μ S/div)
Accuracy I (over center 8 divisions):
(10°C to 35°C)
0.1 μS/div to 1mS/div ±5%
2mS/div to 40mS/div ±7%
Accuracy II (over any divisions within center 8 divisions):
(10°C to 35°C)
0.1 μ S/div to 1mS/div ±15%
2mS/div to 40mS/div ±10%

X-Y OPERATION

Input
X: SOURCE (X MODE)
Y: V MODE (Y MODE)
X-Axis
Sensitivity
Same as Channel 1, Channel 2 or EXT which is selected by SOURCE
(X MODE)
Accuracy: ±5% (10°C to 35°C)
Frequency Response
DC to 500 kHz −3dB
Input RC
Same as Channel 1, Channel 2 or EXT which is selected by SOURCE
(X MODE)
Maximum Input Voltage
Same as Channel 1, Channel 2 or EXT which is selected by SOURCE
(X MODE)
Y-axis
V MODE (Same as Y MODE)
X-Y Phase Difference 3° or less
DC to 20kHz (When SOURCE is set to CH1 or CH2)
DC to 10 kHz (When SOURCE is set to EXT)

Z AXIS

Input Voltage
3 Vp-p for noticeable intensity modulation. Positive-going signal decreases intensity
Frequency Range
DC to 1 MHz
Input Resistance
Approximately 20 KΩ
Maximum Input Voltage
50 V (dc + peak ac)

CALIBRATOR

Waveshape
Square wave
Repetition Rate
1 kHz Accuracy: ±50%
Output Voltage
0.3 V p-p
Accuracy: ±3% (10°C to 35°C)
Duty Ratio
40% to 60%

POWER SUPPLY

Line Voltage
90 to 110/104 to 128/194 to 238/207 to 257 Vac
Selected by the Line Voltage selector
Line Frequency
50 to 400 Hz
Power Consumption
Approximately 30W (at 100 Vac)

PHYSICAL CHARACTERISTICS

Weight
Approximately 6 kg
Dimensions
(260 ±2) W x (160 ±2) H x (400±2) L mm
Refer to Figure 1 on the next page

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature
0°C to 40°C
Operating Humidity
90% RH, 40°C
Storage Temperature
−20°C to 70°C
Storage Humidity
80% RH, 70°C
Altitude
Operating: 5,000 m maximum
(barometric pressure: 405 mmHg)
Non-operating: 15,000m maximum
(barometric pressure: 90.4mmHg)

Vibration (non-operating)
Vibrate for 15 minutes along each axis at a total displacement of 0.67 mm p-p with the frequency varied from 10-55 Hz in one-minute cycle.
Shock (non-operating)
Lift one bottom edge of the instrument 10 cm over a hard bench, and drop.
(45° maximum in elevation angle)
Repeat 3 times for each edge.
Drop (package drop)
Drop from a height of 75 cm on one corner, all edges radiating from that corner and all flat surfaces.

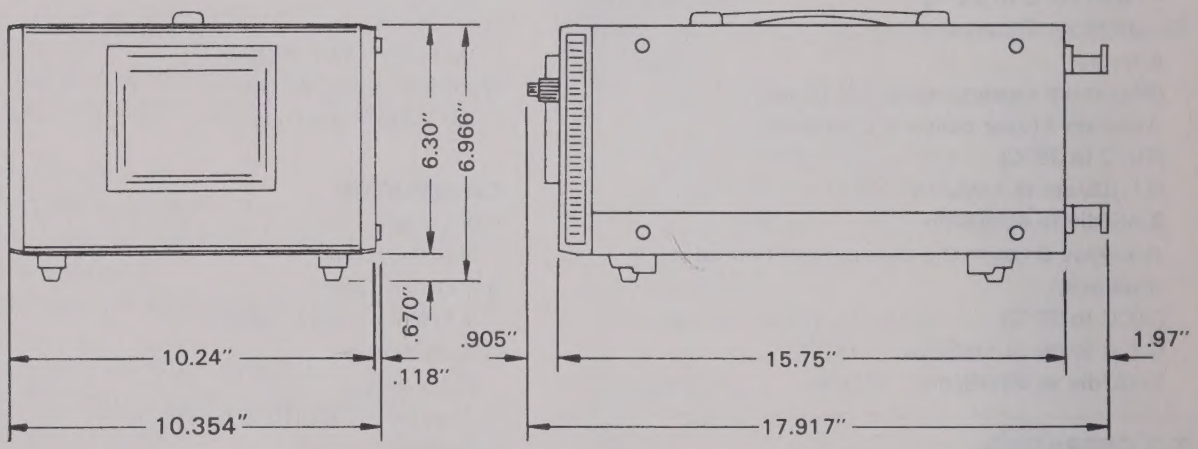

Figure 1
Dimensions

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MAINTENANCE

SECTION 1

WARNING

The following items must be considered when the maintenance work is executed.

1. Dangerous potentials exist at several points throughout this instrument.
2. When the instrument is operated with the cover removed, do not touch exposed connections or components.
3. Some transistors may have Voltage present in the heat sinks.
4. Always disconnect the instrument from the power source before cleaning the instrument or replacing parts.

COVER REMOVAL

The top cover can be removed by loosening four mounting screws and the bottom cover can be removed by loosening one (five) mounting screw(s) respectively.

PREVENTIVE MAINTENANCE

These are the precautions on preventive maintenance which will protect the instrument from trouble and keep it clean over a long period of time.

CLEANING

Since the extent of instrument smearing depends on the ambient condition in which the oscilloscope is used, the frequency of the cleaning operations cannot be defined initially. Cleaning should be accomplished as required. Dust deposited inside the instrument affects the normal flow of cooling air and invites the local overheating of component parts resulting in trouble. Smeared switch contacts of conector pins can be the cause of defective contact, and smearing of the circuit can cause arcing between circuits, particularly in moist seasons.

Cleaning agents recommended and those prohibited are listed in Table 1-1.

TABLE 1-1

Recommended agent	Alcohol, gasoline of kerosene
Prohibited agent	Acetone, tri-ethyl-Ketone, ether, lacquer thinner or agent containing ketone series solvent.

CLEANING THE COVER

Normal smearing of the cover can be cleaned by washing the cover with a neutral chemical cleaner. For greasy smearing, use a recommended agent in Table 1-1 with a soft cloth.

FRONT AND OTHER PANELS

Clean the smeared panel with a soft cloth moistened with a recommended agent. Note that cleaning with alcohol may leave slight blotching. A neutral chemical cleaner may be used but the cleaner left on the panel or knob must be removed with a cloth soaked in water.

DUST IN INSTRUMENT

The best way to remove dust inside the instrument is with compressed air. Remove persistent dust with a soft painting brush and compressed air.

CRT

The CRT screen will be smeared if it is used for too long without the filter. Ordinary dust or fingerprints left on the CRT can be cleaned by a soft cloth. Use a soft cloth moistened with alcohol to remove persistent smearing.

FILTER

The filter may be clogged when used for a long time. Dust or fingerprints can be cleaned with a dry, soft cloth. Use a soft cloth moistened with alcohol to remove persistent smearing.

BEFORE STORING THE OSCILLOSCOPE

Before storing the oscilloscope, remove the probe and adapter from the panel, and store these acessories in the accessory bag provided. Cover the oscilloscope, and store it in a dry place. It prevents deposition of dust.

VISUAL INSPECTION

Periodically inspect the condition of the internal circuit. Burnt resistors, defective contact of connections, a broken printed circuit board and many other defects can be checked easily. Prompt repair of these minor defects can prevent troubles, or limit the defect within minor level.

PERIODICAL CALIBRATION

In order to use the oscilloscope accurately, periodical calibration of circuits is essential. When this oscilloscope is used frequently, a calibration will be required at every 1000 hours of operation. The frequency of calibration may be extended to 6 months, if the oscilloscope is used infrequently.

TROUBLESHOOTING

TROUBLESHOOTING REFERENCE

SCHEMATIC DIAGRAMS

In this manual, schematic diagrams are grouped in general, with the circuit blocks classified in Figure 3-1 of the Operations Manual.

CIRCUIT LAYOUT

Layout of circuits is printed on the circuit board with dotted lines.

PARTS LAYOUT

Refer to part No. printed on the circuit board to identify parts mounted on the board.

COLOR CODE OF RESISTORS AND CAPACITORS

Most of the resistors and capacitors in the circuit are color coded by resistance or capacitance value. See Figure 1-1 for the color code.

ELECTRODE MARKING OF DIODES AND TRANSISTORS

Table 1-2 and 1-3 show the electrode marking of diodes and transistors, by type.

INSTRUMENTS REQUIRED FOR TROUBLESHOOTING

The following instruments are required for troubleshooting this oscilloscope.

(1) Multimeter

Input resistance	: 10 M Ω
Voltage range	: 0 to 300V and special position for 2 KV
Ohm-range	: 0 to 10 M Ω

(2) Transistor curve tracer
(3) Oscilloscope
Frequency bandwidth : DC to 10 MHz
Sensitivity : 5mV/div

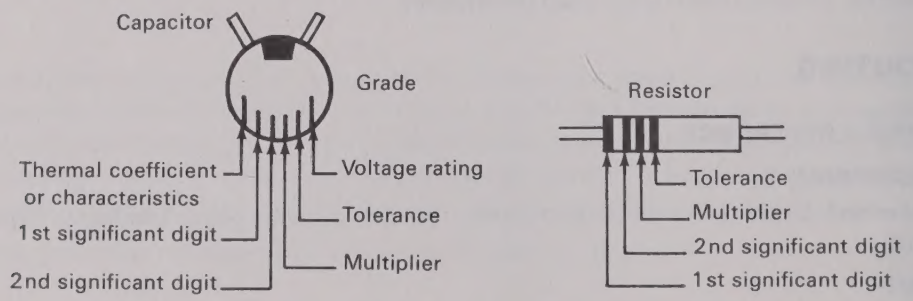
TROUBLESHOOTING STEPS

The first step in troubleshooting is to examine if an irregular event like "circuit trouble" is really due to trouble within the circuit, or by external events. For example, certain irrgular operations will occur, in a normal oscilloscope, if the line voltage is out of the rated voltage range, or a signal input connector is affected by induction of an external signal.

Next, repeatability of the trouble must be checked. For example, when sweep is normal but an irregular signal is displayed with a signal applied to the signal input connector, the signal must be applied to the other input to check if the same irregular display occurs (if it occurs, the oscilloscope is responsible for the trouble).

When troubles persist these preparatory checks must be performed:

1. Remove the covers from the instrument and ascertain the circuit which has the trouble by the troubleshooting flow chart shown in Figure 1-4.
2. Visually inspect parts, wiring, coupling of connectors, soldering and copper foil on the circuit board, which are suspect.
3. Check the action of the ascertained circuit by using a multimeter or test oscilloscope and referring to the voltages and waveforms to those shown in the schematic diagram.
4. Finally, check suspect parts for trouble by using a multimeter or curve tracer and replace the defective parts.



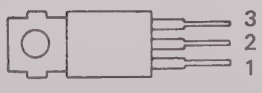
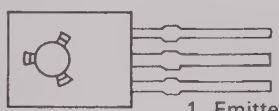
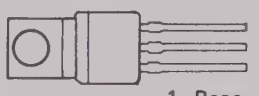
Color	Resistance or capacitance value		Tolerance for resistor	Tolerance for capacitor		Voltage rating for capacitor
	1st or 2nd significant digit	Multiplier		Above 10pF	Below 10pF	
BLK	0	1	–	±20.0	±2.0	–
BRN	1	10	±1	±1.0	–	–
RED	2	10^2	±2	±2.0	–	250V
ORG	3	10^3	–	±2.5	–	300V
YEL	4	10^4	–	–	–	–
GRN	5	10^5	–	±5.0	±0.5	500V
BLU	6	10^6	–	±10.0	–	–
VLT	7	10^7	–	–	–	–
GRY	8	10^8	–	±10.0	±0.25	–
WHT	9	10^9	–	–	±1.0	100V
GOLD	–	10^{-1}	±5	–	–	–
SILVER	–	10^{-2}	±10	–	–	–
No color	–	–	±20	–	–	–

Figure 1-1
Color coding or resistor and capacitor

Table 1-2 Marking for diode electrode

Type of diode	Electrode marking	Polarity
1S953 ESJA35-12		
RD 3.0EB RD 5.1EB		
1G4B1	Top view AC input DC output	
SIRBA	~ – ~ + (Bottom view)	

Table 1-3 Marking for transistor electrode (bottom view)

Type of transistor	Electrode marking
2SC1834 2N3905	1 2 3 1. Emitter 2. Base 3. Collector
2SK30A-Y	1 2 3 1. Source 2. Gate 3. Drain
2SA1015Y/O 2S1815GR	1 2 3 1. Emitter 2. Collector 3. Base
μPA61A	3 4 5 2 6 1 7 8 1. Source 5. Source 2. Drain 6. Drain 3. Gate 7. Gate 4. Case
2SB857C 2SC1061C 2SC1505	 Top view 1. Base 2. Collector 3. Emitter
2SD668	 1. Emitter 2. Collector 3. Base
2SB718 2SC1514 2SD758	 1. Base 2. Collector 3. Emitter

CIRCUIT BOARD REMOVAL

VERTICAL BOARD

1. Remove the top and bottom covers.
2. Disconnect two connectors (yellow and blue wires) from the CRT socket.
3. Disconnect two connectors connected to the INPUT BNC connector(s) and its earth lug(s).
4. Desolder the earth wire.
5. Remove knobs of the VARIABLE control and the VOLTS/DIV switch using the hexagonal wrench provided as an option and loosen nut of the VOLTS/DIV switch and Vertical POSITION controls.
6. Disconnect four connectors on the board.
7. Loosen seven mounting screws.
8. Pull the board backward and outward.

HORIZONTAL BOARD

1. Remove the top and bottom covers.
2. Disconnect two connectors (white and black wires) from the CRT socket.
3. Remove the cover of the CRT circuit by loosening two mounting screws.
4. Remove knob of the POSITION, SWEEP LENGTH, TIME/DIV, VARIABLE and LEVEL controls using the hexagonal wrench provided as an option.
5. Loosen nut of the TIME/DIV switch.
6. Disconnect 13 connectors on the board.
7. Loosen five mounting screws.
8. Pull the board back and outward.

PARTS REPLACEMENT

In this paragraph, the replacement procedures of the defective parts are described.

When the replacement of parts is required, be sure to disconnect the instrument from the power source.

FUSE REPLACEMENT

This instrument uses the fuses shown in Table 1-4 in order to prevent damage to the circuit due to overcurrent.

If these fuses are blown, check its cause correctly, repair the defective parts or circuits, and exchange the blown fuse with the prescribed new ones. The use of a new fuse which is not prescribed may result in danger; therefore, such use is prohibited.

Table 1-4

Circuit No.	Type of Fuses	Function	Location
F701	0.5A slow-blow	Use this fuse when the Line Voltage Selector is set to A or B.	Rear panel
	0.3A slow-blow	Use when the Selector is set to C or D.	
F702	1A slow-blow	Protection of the CRT circuit	Right side board
F703	0.2A fast-blow	Protection of ±240V circuit	(POWER SUPPLY Circuit)

PARTS ON PRINTED CIRCUIT BOARD

When replacing transistors, ICs, diodes, resistors or capacitors mounted on the printed circuit board, particular care must be exercised in the handling of the soldering iron so as not to peel the copper foil off or break parts.

The semiconductors are sensitive to heat. When desoldering or soldering, hold the semiconductor side of the wire lead being heated with pliers or tweezers to absorb the soldering heat. Complete soldering or desoldering quickly.

The semiconductors must be replaced with qualified ones. Refer to Table 1-2 and 1-3 for identification of electrodes. Pins of ICs are numbered as shown in Figure 1-2 when the slot is positioned to the left.

Faulty resistors, capacitors and other passive parts must be also replaced with new ones. Burning out resistors or short circuits in capacitors can occur simultaneously with short circuits in semiconductors or excessive variations in the characteristics. Therefore, check and remove the cause of these defects before replacing the passive parts.

CRT

Dropping of or excessive shock to the CRT is very hazardous. Handle the CRT with special care.

Replace the CRT, when required, by the procedure given below:

1. Remove the top cover.
2. Desolder a wire (blue) between the CRT shield case.
3. Loosen two tightening screws of the rear CRT stopper. (See Figure 1-4).
4. Loosen two tightening screws of the upper CRT stopper.
5. Disconnect the CRT socket.
6. Gradually pull the CRT together with the shield case backward and outward.

The CRT can be mounted in the reverse manner. When the CRT is replaced, the deflection factor and sweep rate must be calibrated.

POWER TRANSISTOR

The power transistors in the CRT and Power Supply circuits are mounted on the heatsink on the horizontal board with an insulation mylar film sheet inserted between the transistor and the heatsink. The mylar sheet is coated with silicon grease to improve the thermal conduction. When replacing these transistors, the mylar sheet coated with silicon grease must be correctly inserted.

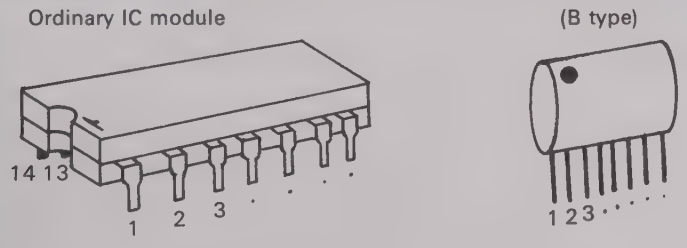


Figure 1-2
Pin No. of IC

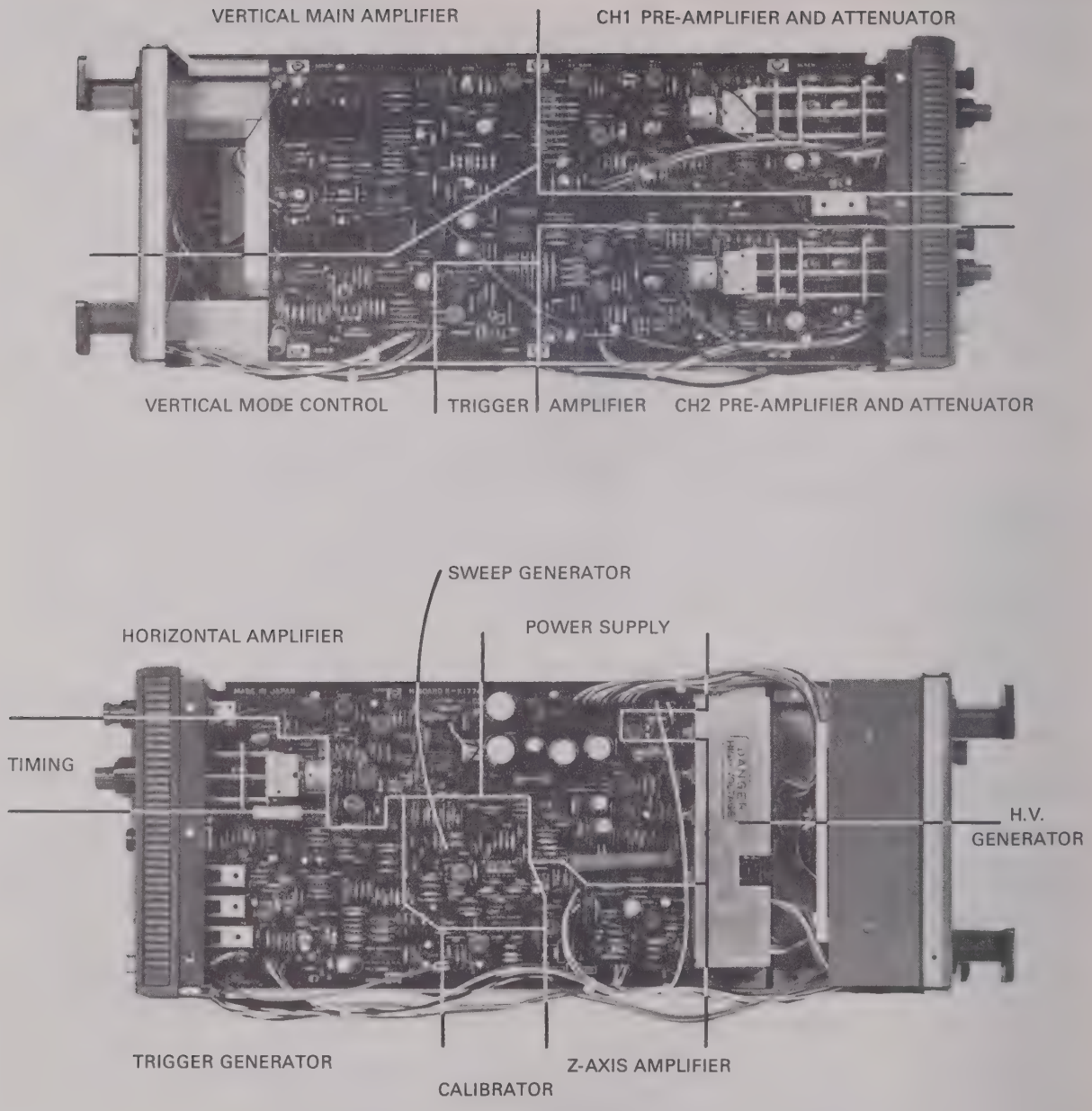


Figure 1-3
Circuit Layout

POWER	Off	POSITION	Mid-range
INTEN	Mid-range	SWEEP LENGTH	Push,
FOCUS	Mid-range	(PULL x5 MAG)	Fully clockwise
SCALE	Fully clockwise	TIME/DIV	1 mSEC
Vertical MODE	CH 1	VARIABLE	CAL
POSITION	Mid-range	LEVEL/SCOPE	Push, Mid-range
VOLTS/DIV	5 mV	SWEEP MODE	NORM
VARIABLE	CAL	COUPLING	AC (EXT DC)
AC-GND-DC	DC	SOURCE	CH 1

Figure 1-4
Troubleshooting flow chart

PERFORMANCE CHECK AND CALIBRATION

SECTION 2

PERIOD OF CHECK AND CALIBRATION

Since the performance of this instrument is subject to aging variation, periodical check and calibration of the device is required.

If the instrument is used frequently, a check and calibration will be required after each 1000 hours, but the interval after the last check and calibration may be prolonged to 6 months, if it is not used so frequently.

INSTRUMENT REQUIRED FOR CHECK AND CALIBRATION

The following measuring instruments and accessories are required in order to provide a performance check and calibration for this instrument.

1. Digital voltmeter
   - Voltage range: 0 to 300V DC (direct)
     Accuracy: ±0.05% +1 dgt.
     0 to 2kV DC (with high-voltage probe)
     Accuracy: ±5% +1 dgt.
2. Oscilloscope
   - Deflection factor: 5 mV/div or more
   - Frequency bandwidth: DC to 20 MHz
3. Scope calibrator
4. Standard signal generator
   - Frequency range: 50 kHz to 20 MHz
   - Output voltage: 80 mVp-p or more (The required output level accuracy must be maintained when the frequency is varied.)
   - Output impedance: 50 Ω
5. Sine wave generator
   - Frequency range: 1 kHz to 20 kHz
   - Output voltage: 40 mVp-p or more
6. Voltage regulator
7. Passive probe (accessory)
8. BNC-T connector
9. 10 dB attenuator
10. 1 : 1 passive probe
11. Adjusting driver

    Example: Probe adjustment screwdriver, an accessory.

NOTES:

1. The performance requirements shown above are the minimum requirements for testing the instruments concerned.
2. Signal input connector of this instrument is the BNC type. If the output connector of a terminator or another test instrument is not BNC type, a conversion connector must be prepared to connect the instrument directly to this oscilloscope.

TABLE FOR CHECK AND CALIBRATION ITEMS

In this paragraph, the check and calibration items are enumerated to show the interaction among the items. When an item which has the interaction for other items is calibrated, those items also must be calibrated. Also, the check and calibration of the vertical deflection system must be performed in numerical order.

– Power Supply and CRT Circuits —
1. Low Voltage Power Supply
   (Interaction: 2 : to 24)
2. Operating Voltage Range
3. CRT Cathode Voltage
   (Interaction: 4, 5, 11, 12, 19, 20, 23, 24, 25)
4. Intensity
5. Focus
6. Parallelness of Trace to Horizontal Graticule Line
7. Pattern Distortion

– Vertical Deflection System –
8. Step Balance
   (Interaction: 9, 10, 11)
9. Variable Balance
10. x 5 MAG Balance
11. Polarity Switching Balance
12. Deflection Factor
    (Interaction: 28)
13. Pulse Response
    (Interaction: 14)
14. Frequency Response
15. Linearity
16. Attenuator Phase

– Calibrator –
17. Output Voltage

– Triggering –
18. Level Centering

– External Horizontal –
19. Position Centering
    (Interaction: 20, 26, 27)
20. Sensitivity
    (Interaction: 19, 26, 27)
21. Pulse Response

– Sweep –
22. Sweep Length
23. Magnifier Centering
24. Sweep Rate
    (Interaction: 25)
25. Sweep Rate at Magnified Sweep

– X-Y Operation –
26. Position Centering
27. Sensitivity
28. Phase Difference

PRECAUTIONS

The following precautions must be observed before checking and calibrating the performance of this instrument.

1. It is assumed, in this section, that the controls have been set to the position described in the section concern--ing "Preparation." Therefore, the controls must be set to the positions given in "Preparation," prior to starting check and calibration of all items or limited to partial ones.

2. Signal outputs of signal generators must be terminated with the rated output impedance (terminator).

3. Since the low power supply voltages are commonly supplied to all circuits, excessive increase in the ripples and voltage error will affect the performance of the circuits. Be sure to check the power supplies before starting the check and calibration of the circuit performance.

4. If a circuit does not operate as described, or it does not satisfy the rated performance, troubleshooting is required as given in the Maintenance section. Repeat calibration of the circuit, after the repair is made.

PREPARATION

Be sure to complete the preparation given below before starting the check and calibration.

1. Adjust the ambient temperature within 18°C to 28°C.
2. Set controls as given below before supplying power to the instrument.

POWER	Off
INTEN	Mid-position
FOCUS	Mid-position
SCALE	Fully clockwise
Vertical MODE	CH 1
POLARITY	NORM
POSITION (Vertical)	Push, Mid-position
VOLTS/DIV	5mV
VARIABLE	CAL
AC-GND-DC	DC
POSITION (Horizontal)	Mid-position
TIME/DIV	1 mSEC
VARIABLE	CAL
LEVEL	Push, Mid-position
SWEEP MODE	AUTO
COUPLING	AC (Ext DC)
SOURCE	CH 1
SWEEP LENGTH	Push, Fully clockwise

3. Set the Line Voltage Selector located on the rear panel to a connection matched to your line voltage. Connect the power cord to the line receptacle. If the line voltage is out of the voltage range covered by the selector, use the voltage regulator to adjust the power supply voltage.
4. Turn on the POWER switch, adjust the intensity of the traces and allow the instrument to warm up for about 15 minutes.

– POWER SUPPLY AND CRT CIRCUITS –

1. LOW VOLTAGE POWER SUPPLY

RATING

Output DC voltages and ripple components must be within the range shown in Table 2-1.

TABLE 2-1

Nominal voltage	Output voltage accuracy	Ripple voltage	Calibration control
+5 V	Within ±0.5V	10 mVp-p	—
−12 V	Within ±0.7V	10 mVp-p	—
+12 V	Within ±0.1V	10 mVp-p	R717
+160 V	150 to 170V	—	—
+240 V	240 to 280V	—	—

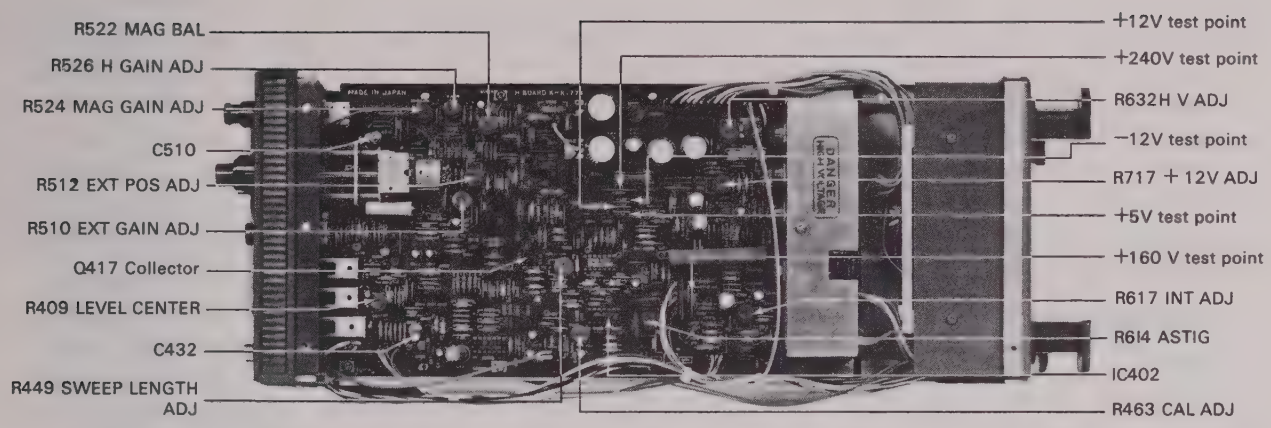
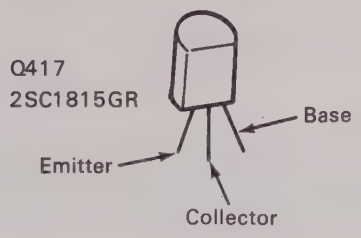


Figure 2-1



CHECK AND CALIBRATION

1. Connect a digital voltmeter between each test point shown in Figure 2-1 and the chassis, and check if the output voltages are within the range given in Table 2-1.
2. If the supply voltages are out of the rating, calibrate the +12V circuit by R717 +12V ADJ (see Figure 2-1), and check the other output voltages (the Power Supply circuit is designed so that the other voltage outputs are within the rated range with no calibration when the calibration of the +12V supply is completed).
3. Set the SWEEP MODE switch to NORM to stop the sweep.
4. Check the amplitude of the ripple component of each DC line by using a test oscilloscope. Increase the vertical deflection factor of the test oscilloscope to 5 or 10 mV/div and use a 1 : 1 passive probe.

2. OPERATING VOLTAGE RANGE

RATING

The display must be sufficiently stable against variation in the operating voltages given in Table 2-2.

TABLE 2-2

Line voltage selector	Center voltage	Voltage range	Fuse
A	110V AC	90 to 110V	0.5A Slow
B	117V AC	104 to 128V	0.3A Slow
C	217V AC	194 to 238V	
D	234V AC	207 to 257V	

CHECK

1. Turn off the POWER switch and disconnect the power cord from the line receptacle. Connect the power cord to the line through a voltage regulator (slide auto transformer), and set the regulator output voltage to the rated center voltage (see Table 2-2).
2. Turn on the POWER switch and connect the CAL OUT terminal to the input connector using the accessory probe. The signal amplitude should be 6 divisions.
3. Set the TIME/DIV switch to 10 mSEC.
4. Vary the regulator output voltage continuously within the rated voltage range. Neither ripple nor intensity modulation must appear in the display.

3. CRT CATHODE VOLTAGE

RATING

The CRT cathode voltage with respect to the ground must be within −1950 ±50V.

NOTE: If the CRT cathode voltage is within the rating, this voltage must not be calibrated excepting the following cases.

1. Overall calibration of all items.
2. Calibration of the deflection factor and the sweep rate.

CHECK AND CALIBRATION

1. Check that the CRT cathode voltage is within the rating, by connecting a digital voltmeter (with a high voltage probe) between CRT cathode voltage test point (see Figure 2-2) and chassis.
2. If the voltage is out of the rating, adjust R632 HV ADJ (see Figure 2-1).

4. INTENSITY

RATING

A spot must appear when the INTEN control is rotated fully clockwise, and the trace must disappear when the control is rotated fully counterclockwise.

CHECK AND CALIBRATION

1. Set the SWEEP MODE switch to NORM to stop the sweep.

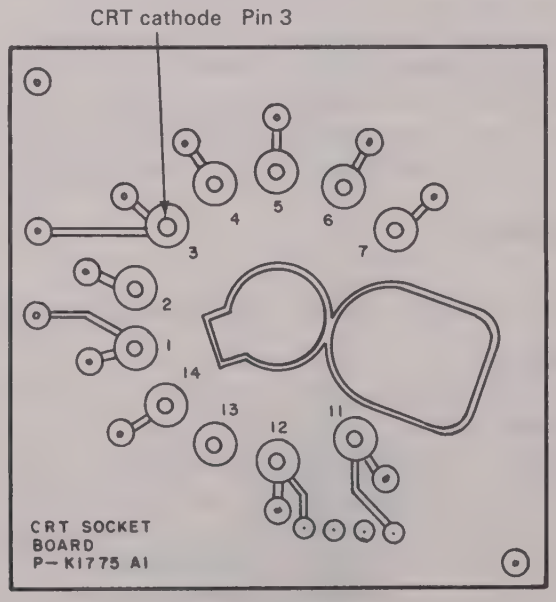


Figure 2-2
Voltage of CRT cathode

2. Rotate the INTEN control fully clockwise and check that a spot is visible on the CRT.
3. Start the sweep by setting the SWEEP MODE switch to AUTO.
4. Rotate the INTEN control fully counterclockwise and check that the trace disappears.
5. If above checks reveal unsatisfactory result, adjust R617 INT ADJ (see Figure 2-1).

5. FOCUS

CHECK AND CALIBRATION

1. Connect the OUTPUT 2 signal of the scope calibrator SC-340 to the INPUT connector and push the SINE WAVE left button of the SC-340.
2. Rotate the VOLTS/DIV switch and the VARIABLE control to set the displayed amplitude to 8 divisions.
3. Adjust the INTEN and FOCUS controls in order to obtain the optimum sharpness of the trace and check that the trace of the waveform on the whole viewing area is sharp.
4. If the trace is not sharp, adjust R614 ASTIG (see Figure 2-1).

6. PARALLELNESS OF TRACE TO HORIZONTAL LINES

NOTE: As the parallelness of the trace to a graticule line is somewhat affected by the ground magnetism, check and calibrate the instrument in the actual used position.

CHECK AND CALIBRATION

1. Adjust the vertical POSITION control to see the trace on the horizontal center line of the graticule and check the parallelness of trace to the line.
2. If the trace is not parallel to the center line, adjust the TRACE ROTATION controller on the front panel.

7. PATTERN DISTORTION

RATING

When a raster is fully displayed in the 8 divisions (V) by 10 divisions (H) area, the sides of the raster must be straight not exceeding the limit 0.13 division (vertical) and 0.1 division (horizontal) as shown in Figure 2-3.

CHECK AND CALIBRATION

1. Connect the signal of a sine wave generator to the INPUT connector.
2. Adjust the signal output level to set the displayed amplitude to 8 divisions.
3. Set the signal frequency to approximately 20 kHz and the TIME/DIV switch to 1 mSEC so that a raster may be displayed.
4. Check the curvature of the upper and lower ends of the raster from the horizontal lines of the graticule.
5. Adjust the horizontal POSITION control to set the vertical ends of the raster with the left or the right ends of the vertical line, and check the curvature of the raster from the lines.

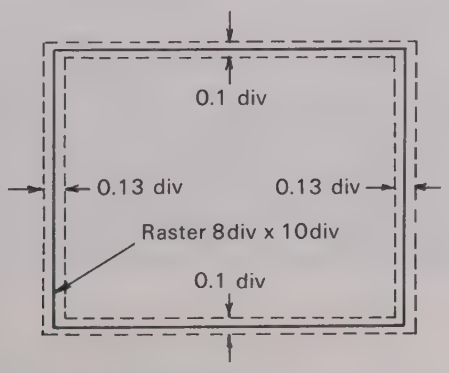


Figure 2-3
Pattern distortion

8. STEP BALANCE

CHECK AND CALIBRATION

1. Set the vertical MODE switch to DUAL.
2. Set the traces to vertical center-line graticule by the Vertical POSITION controls.
3. Rotate the VOLTS/DIV switches of CH 1 and CH 2 from 5 mV to 20 mV and check the trace shift to the vertical direction.
4. If the traces shift, adjust R013 (CH 1)/R113 (CH 2) DC BAL (see Figure 2-4).

9. VARIABLE BALANCE

CHECK AND CALIBRATION

1. Set the Vertical MODE switch to DUAL.
2. Set the traces to vertical center-line graticule by the vertical POSITION controls.
3. Rotate the VARIABLE controls of CH 1 and CH 2 and check the trace shift to the vertical direction.
4. If the traces shift, adjust R035 (CH 1)/R135 (CH 2) VAR BAL (see Figure 2-4).

10. x5 MAG BALANCE

CHECK AND CALIBRATION

1. Set the vertical MODE switch to DUAL.
2. Set the traces to horizontal center-line graticule by the CH 1 and CH 2 vertical POSITION controls.
3. The traces are not shifted when the POSITION controls are pushed and pulled.
4. If the traces are shifted, adjust R041 (CH 1)/R141 (CH 2) MAG BAL (see Figure 2-4).

11. POLARITY SWITCHING BALANCE

CHECK AND CALIBRATION

1. Set the switches as follows:

Vertical MODE	CH 2
AC-GND-DC (CH 2)	GND

2. Set the CH 2 trace to horizontal center-line graticule by the CH 2 Vertical POSITION control.
3. The trace is not shifted when the POLARTIY switch is swithced to INV/NORM.
4. If the trace is shifted, adjust R219 POS ADJ (see Figure 2-4).

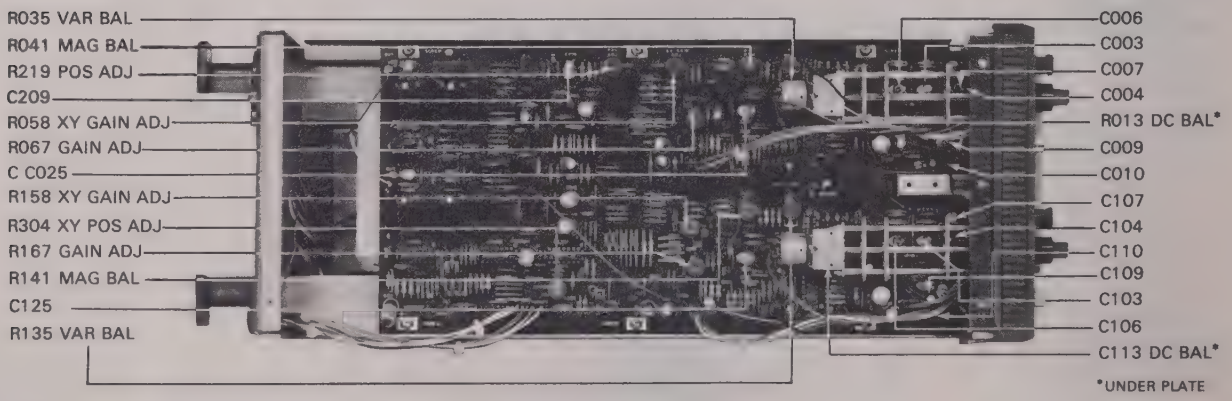


Figure 2-4
Calibration controls (left)

12. DEFLECTION FACTOR

RATING

within ±4%

CHECK AND CALIBRATION

1. Connect the OUTPUT 2 signal of the scope calibrator, SC-340 to the INPUT connector.
2. Set the VOLTS/DIV switches to 20mV.
3. Set the controls of the SC-340 as follows:
   SQUARE WAVE 1 Push
   AMPLITUDE 120 mV
4. Shift the display to the center of the viewing area and check if the displayed amplitude is within 6 divisions ±4%.
5. Check the accuracy of each deflection factor by rotating the VOLTS/DIV and AMPLITUDE switches as shown in Table 2-3.
6. If the accuracy is out of the rating, calibrate it with R067 (CH 1)/R167 (CH 2) GAIN ADJ (see Figure 2-4)

TABLE 2-3

Setting of VOLTS/DIV	Setting of AMPLITUDE	Displayed Amplitude
5	30	6 div±4%
10 mV	60 mV	6 div±4%
20	120	6 div±4%
50	.3	6 div±4%
.1	.6	6 div±4%
.2	1.2	6 div±4%
.5 V	3 V	6 div±4%
1	6	6 div±4%
2	12	6 div±4%
5	30	6 div±4%
10	60	6 div±4%

13. PULSE RESPONSE

RATING

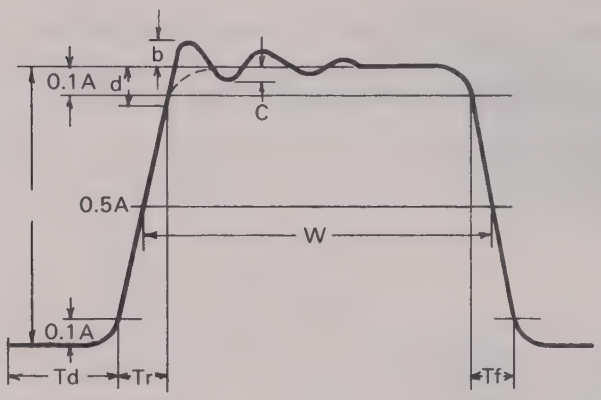
Overshoot: 8%
Sag (at 1 kHz): 2%
Other distortion: 7%
(In 10 mV/div to 20 m/div and the center 4 divisions of the CRT. Refer to Figures 2-5 and 2-6.)

CHECK AND CALIBRATION

1. Connect the OUTPUT 3 signal of the SC-340 to the INPUT connector using a 10 dB attenuator.
2. Set the controls of the SC-340 as follows:
   SQUARE WAVE 2 Push
   REPETITION 1 kHz
   AMPL Adjust to set the displayed amplitude to 4 divisions.
3. Shift the display to the center of the viewing area and check the sag.
4. Set the REPETITION switch to 500 kHz, the TIME/DIV switch to 0.5 μSEC and pull the x5 MAG switch.
5. Check the overshoot and other distortion.

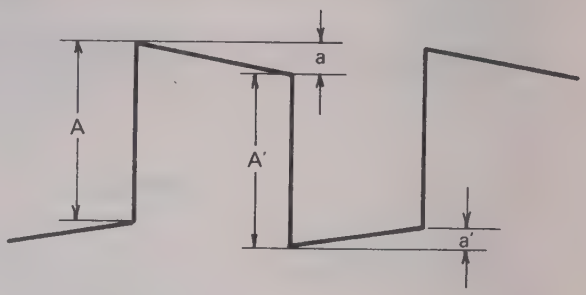
6. If the overshoot exceeds the rating, adjust the following calibration controls (see Figure 2-4).
   Note that these controls must be adjusted so that the rising edge of the waveform can rise as sharp as possible while minimizing overshoot, otherwise, frequency response will be affected.
   For CH 1: C025
   For CH 2: C125
   Common to CH 1 and CH 2: C209

   NOTE: When the above adjustment is made, the frequency response must be checked with the procedure explained in the following item, Frequency Response.



A; Basic amplitude
b/A: Overshoot
c/A: Ringing
W: Pulsewidth
T: Rise time
Tf: Fall time
d/A: Rounding
Td: Signal delay time

Figure 2-5
Definition of pulse terms



A: Basic amplitude
a: Sag
Sag = a/A (or a®/A® whichever large) x 100%

Figure 2-6
Sag waveform

14. FREQUENCY RESPONSE

RATING

DC to 20 MHz −3 dB
(In the center 4 divisions of the CRT.)

CHECK

1. Connect the output signal of a standard signal generator to the CH 1 INPUT connector.
2. Set the signal frequency to 50 kHz and adjust the signal output level to set the displayed amplitude to 4 divisions.
3. Shift the display to the center 4 divisions area.
4. Set the signal frequency to 20 MHz and check if the displayed amplitude is 2.83 divisions or more (−3 dB referred to 4 divisions).
5. Check the CH 2 as above method.

15. LINEARITY

RATING

±5% (at 1 kHz)

CHECK

1. Connect the OUTPUT 2 signal of the SC-340 to the INPUT connector and push the SINE WAVE left button.
2. Rotate the VOLTS/DIV switch and the VARIABLE control to set the displayed amplitude to 2 divisions in the center 2 divisions area.
3. Shift the waveform to the upper/lower of the graticule area until the top/bottom of the waveform reaches the end of the graticule and check that the variation of the display amplitude is within 0.1 division (±5%).

16. ATTENUATOR PHASE

RATING

Overshoot or rounding: ±3%
Flatness: ±4%

CHECK

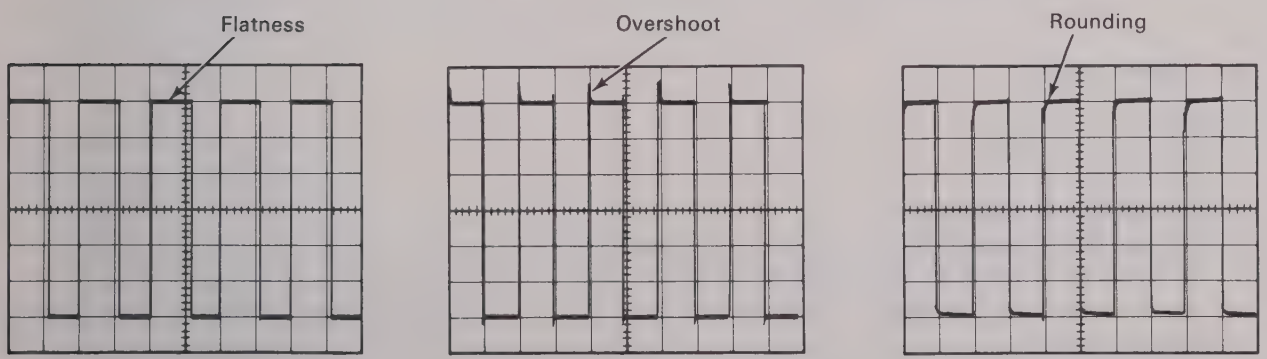
1. Connect the accessory probe between the INPUT connector and the OUTPUT 2 connector of the SC-340.
2. Set the probe switch to x10 and the TIME/DIV switch to 0.5 mSEC.
3. Push the SQUARE WAVE 1 button and set the AMPLITUDE switch to 0.3V.
4. As the above-mentioned operation allows 6 divisions amplitude of the signal on the CRT, adjust the phasing capacitor of the probe so that the correct phasing can be obtained. (See Figure 2-7).
5. Set the VOLTS/DIV switch and the AMPLITUDE switch to 50 mV and 3 V respectively and check if the correct phasing is given in the overshoot or rounding and flatness.
6. Similarly, check the phasing in each range of the VOLTS/DIV switch.

CALIBRATION

Adjust the calibration controls shown in Table 2-4 and Figure 2-7.

TABLE 2-4

VOLTS/DIV	CH 1		CH 2	
	Overshoot or rounding	Flat-ness	Overshoot or rounding	Flat-ness
5mV	—	Phase adjuster of probe	—	Phase adjuster of probe
10mV~50mV	C003	C004	0103	C104
0.1V~0.5V	C006	C007	C106	C107
1V~10V	C009	C010	C109	C110



(a) Correct phasing (b) Incorrect (over-compensation) (c) Incorrect (poor compensation)

Figure 2-7
Attenuator phase

– CALIBRATOR –

17. OUTPUT VOLTAGE

RATING

0.3V ±3%

CHECK AND CALIBRATION

1. Connect the CAL OUT signal to the INPUT connector.
2. Set the VOLTS/DIV switch to 50 mV and check that the displayed amplitude of the CAL OUT signal is within 6 divisions ±3%.
3. If it is out of the rating, adjust 463 CAL ADJ (See Figure 2-1).

– TRIGGERING –

18. LEVEL CENTERING

CHECK AND CALIBRATION

1. Connect the OUTPUT 2 signal of the SC-340 to the INPUT connector.
2. Push the SINE WAVE left button of the SC-340 and rotate the VOLTS/DIV switch and its VARIABLE control to set the displayed amplitude to 6 divisions.
3. Shift the display to the center 6 divisions of the graticule.
4. Allow the triggering by setting the LEVEL/SCOPE control to the mid-range.
5. Repeat the push-pull switching of the LEVEL/SLOPE control and check if the sweep start points of positive-going and negative-going slopes are positioned on the horizontal center line of the graticule.
6. If the start points deviate from the center line, adjust R408 LEVEL CENTER (see Figure 2-1).

– EXTERNAL HORIZONTAL –

19. POSITION CENTER

CHECK AND CALIBRATION

1. Set the SOURCE switch to EXT.
2. Set the start point of the trace to the left-end of the vertical graticule when the TIME/DIV switch is set to 1 mSEC.
3. Spot is appeared at center of vertical graticule when the TIME/DIV switch is switched to X-Y.
4. If the spot is not at center of vertical graticule, adjust R512 EXT POS (see Figure 2-1).

20. SENSITIVITY

RATING

0.5V/div within ±5%

CHECK AND CALIBRATION

1. Set the TIME/DIV and SOURCE switches to X-Y and EXT.
2. Connect the OUTPUT 2 signal of the SC-340 to the HORIZ IN connector.
3. Set the controls of the SC-340 as follows and check if the trace length is within 6 divisions ±0.3 division.

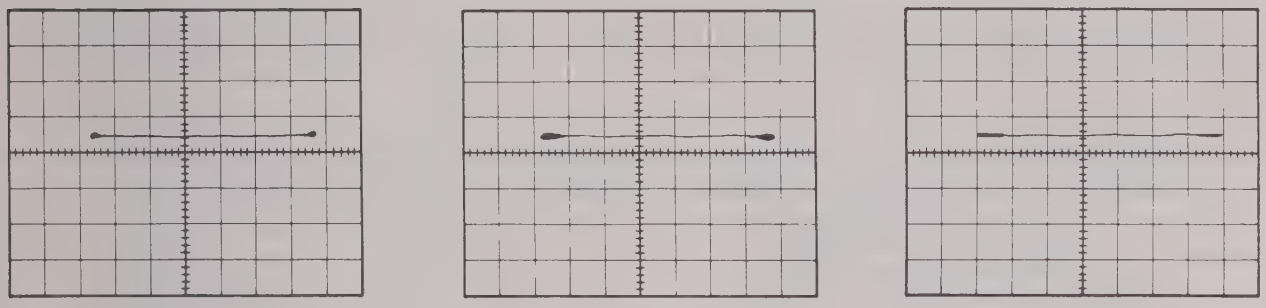
SQUARE WAVE 1	Push
AMPLITUDE	3V

4. If the error is large, adjust R510 EXT GAIN (see Figure 2-1).

21. SQUARE WAVE-FORM RESPONSE

CHECK AND CALIBRATION

1. Set the switches as follows:
   SOURCE EXT
   TIME/DIV X–Y
2. Connect the OUTPUT 3 signal of the SC-340 to the HORIZ IN connector.
3. Push the SQUARE WAVE 2 button of the SC-340 and set the REPETITION switch to 20 kHz.
4. Adjust the AMPL control of the SC-340 and display the trace horizontally to 6 divisions at center of the CRT screen.
5. Check if the waveform is correctly displayed as shown in Figure 2-8 (a).
6. If the waveform is displayed as shown in Figure 2-8 (b) or (c), adjust C432 (see Figure 2-1).



(a) (b) (c)

Figure 2-8
Distortion of square waveform

– HORIZONTAL DEFLECTION SYSTEM –

22. SWEEP LENGTH

CHECK AND CALIBRATION

1. Set the TIME/DIV switch to 1 mSEC and its VARIABLE control to CAL.
2. Push the PULSE TRAIN left button of the SC-340 and connect the OUTPUT 2 signal to the INPUT connector.
3. Set the REPETITION switch to 0.5 mSEC and check if 22 pulses are displayed on the CRT.
4. If the error is large, adjust R449 SWEEP LENGTH ADJ (see Figure 2-1).

23. MAGNIFIER CENTERING

CHECK AND CALIBRATION

1. Connect the CAL OUT signal to the INPUT connector.
2. Set the start point of the display (rising of the CAL OUT signal) to the vertical center line of the graticule with the horizontal POSITION control.
3. Pull the PULL x5 MAG switch and check if the start point shifts from the vertical center line.
4. If the start point shifts excessively, set the start point of the magnified sweep correctly to the vertical center line with the horizontal POSITION control. Next push the PULL x5 MAG switch and adjust R522 MAG BAL (see Figure 2-1) so that the start point of the unmagnified sweep is positioned to vertical center line correctly.

24. SWEEP RATE

RATING

Accuracy I (over center 8 divisions):

0.5μS/div to 5mS/div:	±4%
10mS/div to 0.2S/div:	±5%

Accuracy II (over any 2 divisions within center 8 division): ±10%

CHECK

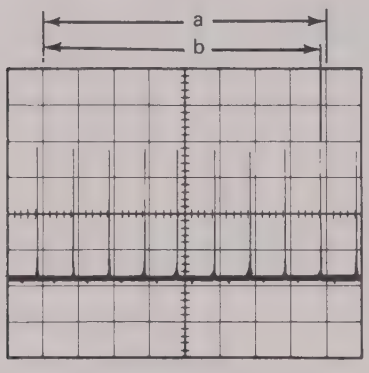
1. Connect the OUTPUT 2 signal of the SC-340 to the INPUT connector.
2. Set the controls of the SC-340 as follows:

PULSE TRAIN	Push the left button
REPETITION	1 mSEC

3. Allow triggering and check the accuracy I and II (see Figure 2-9).
4. Repeat the same check of the accuracy for different combinations of the settings between the TIME/DIV and REPETITION switches.

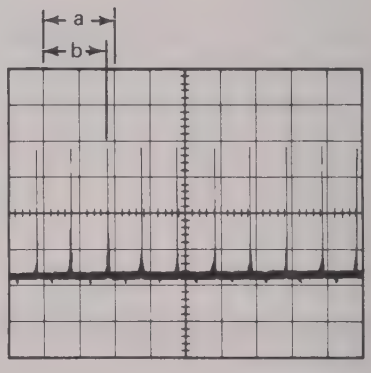
CALIBRATION

1. Calibrate the accuracy for ranges from 0.2S/div to 50μS/div with R526H GAIN ADJ (see Figure 2-1).
2. Calibrate the accuracy for ranges from 20μS/div to 0.5μS/div with C510 (see Figure 2-1).



Error rate = $\frac{a - b}{a}$ x 100 (%)

where a: Horizontal effective scale (8 div)
b: Measured value of pulse train corresponding to a.



Error rate = $\frac{a - b}{a}$ x 100 (%)

where a: Any 2 divisions of effective scale
b: Measured value of pulse train corresponding to a.

Figure 2-9
Sweep rate error

25. SWEEP RATE MAGNIFIED SWEEP

RATING

Accuracy I (over center 8 divisions): ±5%

0.1μS/div to 1mS/div:	±5%
2mS/div to 40mS/div:	±7%

Accuracy II (over any 2 divisions within center 8 divisions):

0.1μS/div to 1mS/div:	±15%
2mS/div to 40mS/div:	±10%

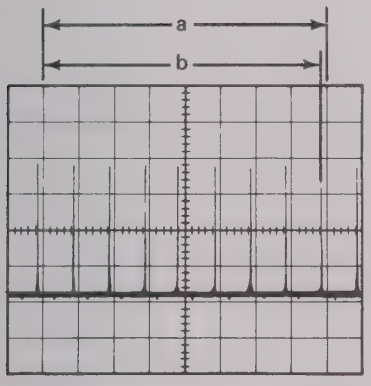
NOTE: The above-mentioned accuracy is rated excepting 300 ns from the start point and end of the sweep.

CHECK

1. After the check procedure explained in "Sweep Rate," set the TIME/DIV and REPETITION switches to 0.2 mSEC and shift the start pulse to the left end of the graticule.
2. Set the TIME/DIV switch to 1 mSEC and pull the PULL x5 MAG switch.
3. Check the accuracy I and II (see Figure 2-10).
4. Repeat the same check of the accuracy for different combinations of the settings between the TIME/DIV and REPETITION switches.

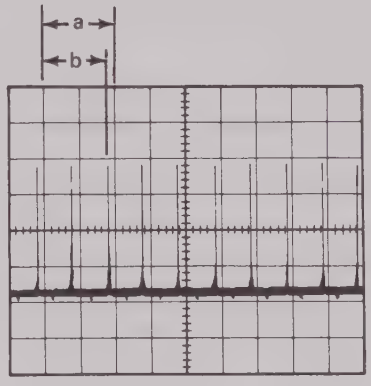
CALIBRATION

If the error is large, adjust the magnified sweep rate with R524 MAG GAIN ADJ (see Figure 2-1).



Error rate = $\frac{a - b}{a}$ x 100 (%)

where a: Horizontal effective scale (8 div)
b: Measured value of pulse train corresponding to a.



Error rate = $\frac{a - b}{a}$ x 100 (%)

where a: Any 2 divisions of effective scale
b: Measured value of pulse train corresponding to a.

Figure 2-10
Sweep rate error at magnified sweep

– X-Y SCOPE –

26. POSITION CENTER

CHECK AND CALIBRATION

1. Set the switches as follows:
   TIME/DIV X-Y
   SOURCE EXT
2. The spot is appeared at center of vertical graticule.
3. The spot is not shifted by switching the SOURCE switch to CH 2.
4. If the spot is shifted by above methods, adjust R 304 X-Y POS ADJ (see Figure 2-4).

27. SENSITIVITY

RATING

± 5%
± 7% (When the PULL x5 MAG switch is pulled)

CHECK AND CALIBRATION

1. Set the control as follows:

Vertical MODE	CH 2
TIME/DIV	X-Y
SOURCE	CH 1
VOLTS/DIV (CH 1, CH 2)	20mV

2. Connect the OUTPUT 2 signal of the SC-340 to the CH 1 INPUT connector and set the SC-340 controls as follows:

SQUARE WAVE 1	Push
AMPLITUDE	120mV

3. Shift the trace to the vertical center 6 divisions and check that the trace length is within 6 divisions ± 5%.
4. If the error is large, adjust R058 X-Y GAIN ADJ (see Figure 2-4).
5. Connect the OUTPUT 2 signal to the CH 2 INPUT connector.
6. Set the controls as follows:

Vertical MODE	CH 1
SOURCE	CH 2

7. Shift the trace to the horizontal center 6 divisions and check that the trace length is within 6 divisions ±0.5%.
   If the accuracy is poor, adjust R158 X-Y GAIN (see Figure 2-4).

28. PHASE

RATING

Within 3° (for DC to 20 kHz sine wave)

CHECK

1. Set the controls as given at the item 1 of the sensitivity check and calibration.
2. Connect the signal of a sine wave generator to the CH 1 INPUT and CH 2 INPUT connectors by using a BNC-T connector.
3. Set the signal frequency to 20 kHz, and adjust the signal output level to set the horizontal amplitude of the Lissajou's pattern to 6 divisions.
4. Check the width "a" in Figure 2-11 which must be smaller than 0.3 division.

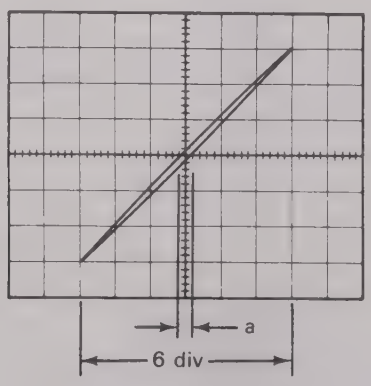


Figure 2-11
X - Y phase difference

SCHEMATIC DIAGRAMS

SECTION 3

VOLTAGE AND WAVEFORMS

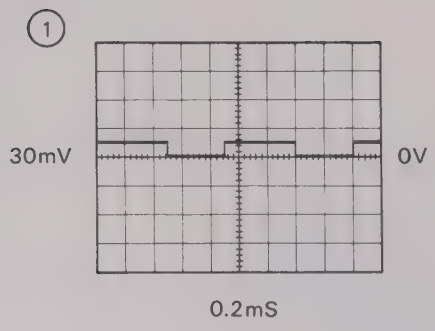
On the back side of the schematic diagrams, the voltages and waveforms in the normal acting of the instrument are shown. These voltage and waveforms are useful for troubleshooting.

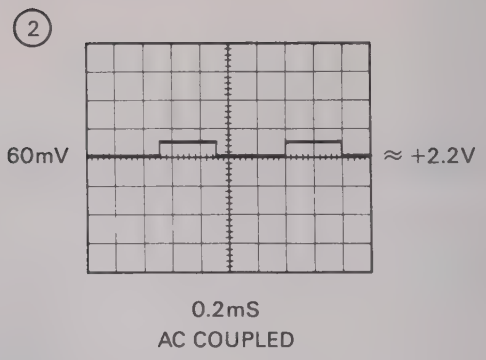
The voltages and waveforms are measured by the following condition.

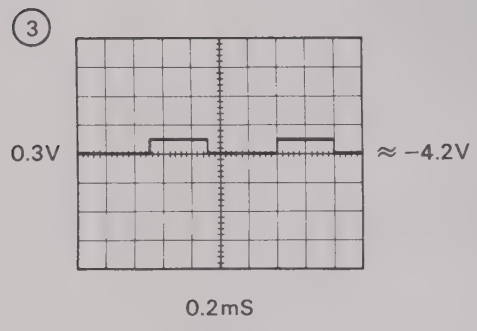
1. The CAL 0.3V signal is connected to the input connector as the test signal. For this connection, the following probes are used.
   For connections to Channel 1 and Channel 2 input connectors: 10 : 1 passive probe.
2. The switches and controls of this instrument are set as follows:

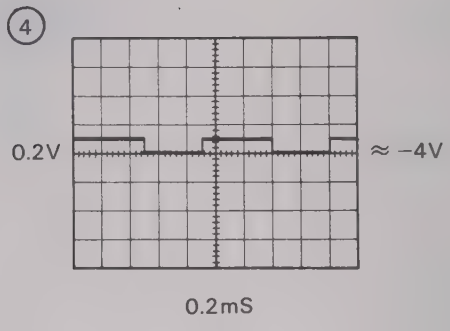
POWER	On
INTEN	Mid-position
FOCUS	Mid-position
SCALE	Arbitrary position
V MODE	CH 1
AC-GND-DC (CH 1, 2)	DC
VOLTS/DIV (CH 1, 2)	10mV
VARIABLE (CH 1, 2)	CAL
POSITION (CH 1, 2)	Push, adjust to set the waveform to the
(PULL x 5 MAG)	center of the graticule area.
CH 2 POLARITY	NORM (▁▁)
SWEEP MODE	AUTO
COUPLING	AC
SOURCE	CH 1
LEVEL-SCOPE	Push, mid-position
TIME/DIV	1mSEC
VARIABLE POSITION	CAL Adjust to set the start point of the waveform to the left end of the graticule area.
SWEEP LENGTH (PULL X 5 MAG)	Push, mid-position

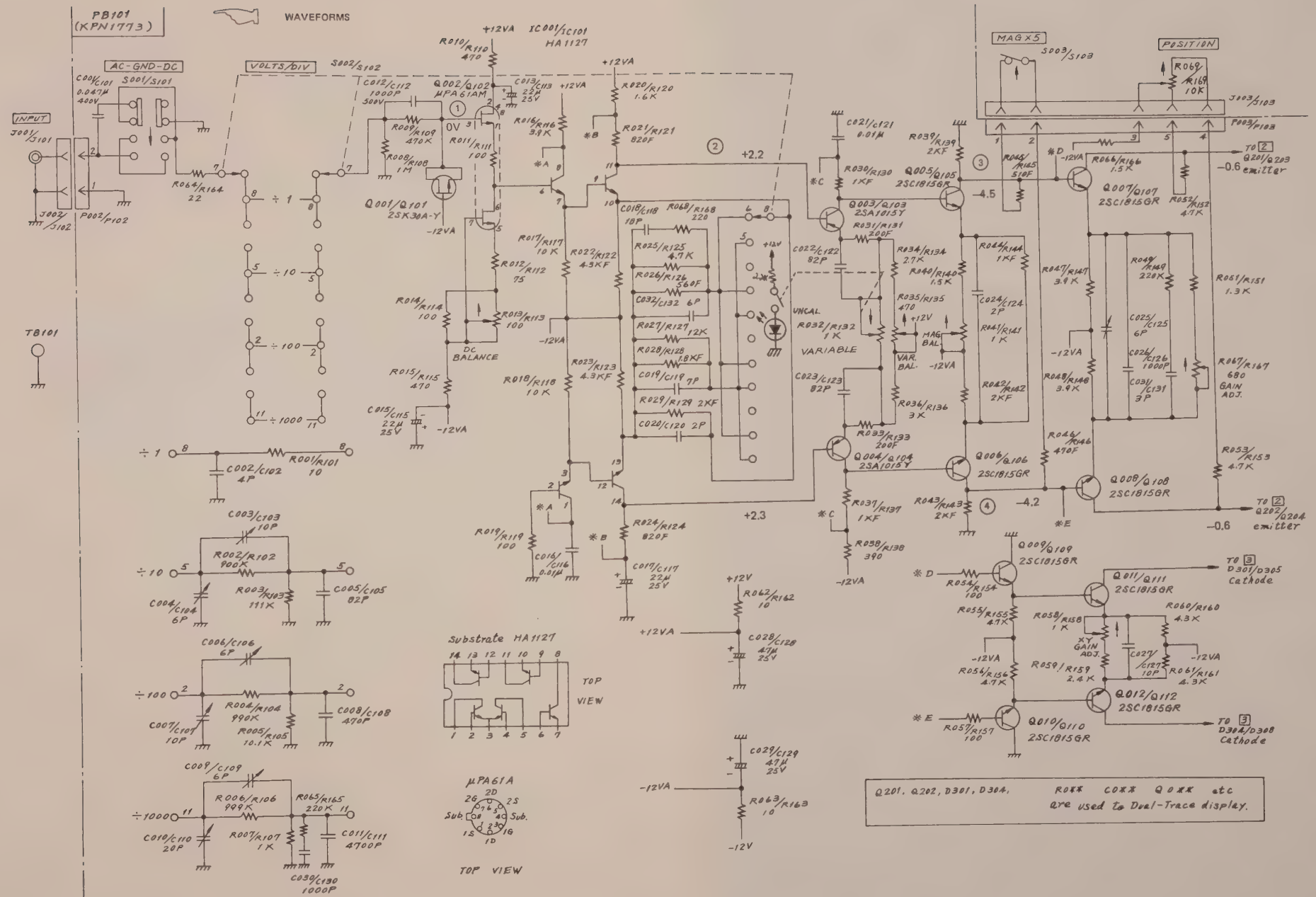
3. Exceptions in the controls setting are shown by "VOLTAGE & WAVEFORM READING CONDITIONS" noted on the schematic diagram. Besides, the asterisks marked on the diagrams show the point measured by the exceptional settings.
4. The waveforms which starting from the negative slope are measured by setting the SLOPE switch of a test oscilloscope to —.

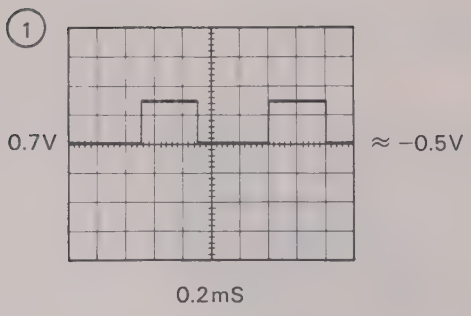

1
30mV
0V
0.2mS

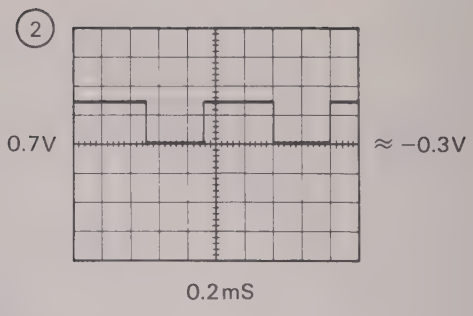

2
60mV
≈ +2.2V
0.2mS
AC COUPLED

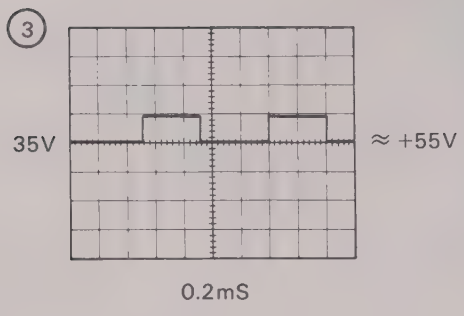

3
0.3V
≈ −4.2V
0.2mS

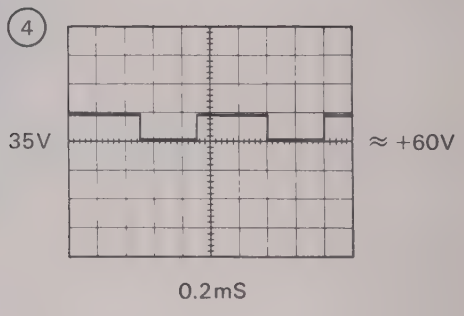

4
0.2V
≈ −4V
0.2mS

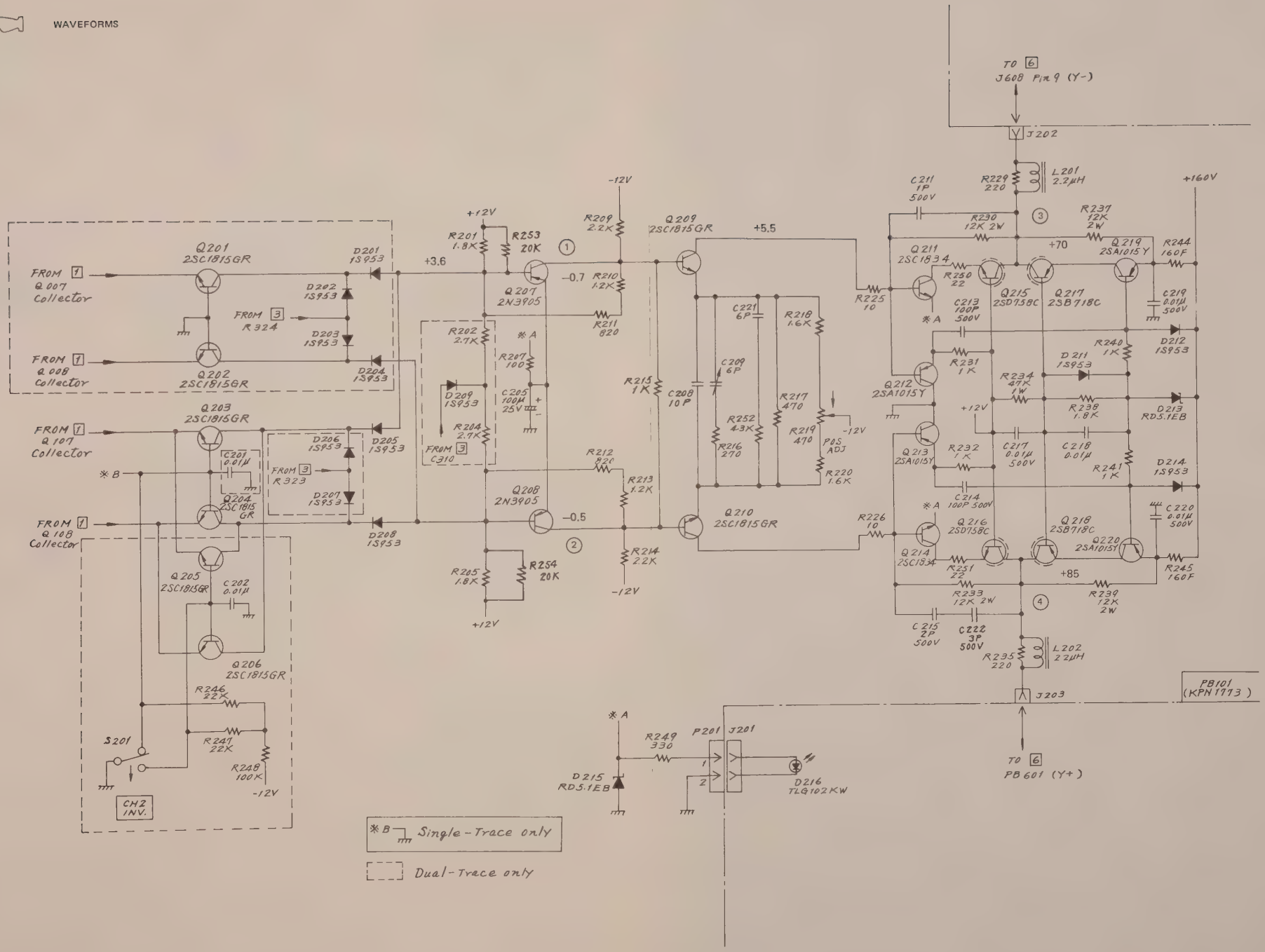

PB101 (KPN1773)
WAVEFORMS
INPUT
J001/J101
J002/J102
TB101
AC-GND-DC
S001/S101
C001/C101 0.047μ 400V
VOLTS/DIV
S002/S102
P002/P102
R064/R164 22
÷1
÷10
÷100
÷1000
C002/C102 4P
R001/R101 10
C003/C103 10P
R002/R102 900K
R003/R103 111K
C004/C104 6P
C005/C105 82P
C006/C106 6P
R004/R104 990K
R005/R105 10.1K
C007/C107 10P
C008/C108 470P
C009/C109 6P
R006/R106 999K
R065/R165 220K
C010/C110 20P
R007/R107 1K
C011/C111 4700P
C039/C130 1000P
C012/C112 1000P 500V
Q002/Q102 μPA61AM
C013/C113 22μ 25V
R008/R108 1M
R009/R109 470K
0V
R011/R111 100
Q001/Q101 2SK30A-Y
-12VA
R010/R110 470
+12VA
IC001/IC101 HA1127
R016/R116 3.9K
R017/R117 10K
R012/R112 75
R014/R114 100
R013/R113 100
DC BALANCE
R015/R115 470
C015/C115 22μ 25V
R018/R118 10K
R023/R123 4.3KF
R019/R119 100
C016/C116 0.01μ
R020/R120 1.6K
R021/R121 820F
R022/R122 4.3KF
C018/C118 18P
R025/R125 4.7K
R026/R126 560F
C032/C132 6P
R027/R127 12K
R028/R128 1.8KF
C019/C119 7P
R029/R129 2KF
C020/C120 2P
R024/R124 820F
C017/C117 22μ 25V
+2.2
+2.3
Substrate HA1127
TOP VIEW
μPA61A
TOP VIEW
R062/R162 10
C028/C128 47μ 25V
C029/C129 47μ 25V
R063/R163 10
-12V
C021/C121 0.01μ
R030/R130 1KF
Q003/Q103 2SA1015Y
R031/R131 200F
C022/C122 82P
R032/R132 1K VARIABLE
UNCAL
R034/R134 2.7K
R040/R140 1.5K
R035/R135 470
MAG BAL
VAR. BAL.
C023/C123 82P
R036/R136 3K
R033/R133 200F
Q004/Q104 2SA1015Y
R037/R137 1KF
R038/R138 390
R039/R139 2KF
Q005/Q105 2SC1815GR
-4.5
R043/R143 2KF
-4.2
MAG X5
S003/S103
POSITION
R069/R169 10K
J003/J103
P003/P103
R045/R145 510F
R044/R144 1KF
R042/R142 2KF
R041/R141 1K
C024/C124 2P
R046/R146 470F
Q006/Q106 2SC1815GR
Q007/Q107 2SC1815GR
R066/R166 1.5K
R052/R152 4.7K
-0.6
TO 2 Q201/Q203 emitter
R047/R147 3.9K
R048/R148 3.9K
R049/R149 220K
C025/C125 6P
C026/C126 1000P
C031/C131 3P
R067/R167 680 GAIN ADJ.
R051/R151 1.3K
R053/R153 4.7K
Q008/Q108 2SC1815GR
-0.6
TO 2 Q202/Q204 emitter
Q009/Q109 2SC1815GR
R054/R154 100
R055/R155 4.7K
R056/R156 4.7K
Q010/Q110 2SC1815GR
R057/R157 100
Q011/Q111 2SC1815GR
R058/R158 1K
XY GAIN ADJ.
R059/R159 2.4K
R060/R160 4.3K
C027/C127 10P
R061/R161 4.3K
Q012/Q112 2SC1815GR
TO 3 D301/D305 Cathode
TO 3 D302/D308 Cathode
Q201, Q202, D301, D304, RXX CXX QXX etc are used to Dual-Trace display.


1
0.7V
≈ −0.5V
0.2mS

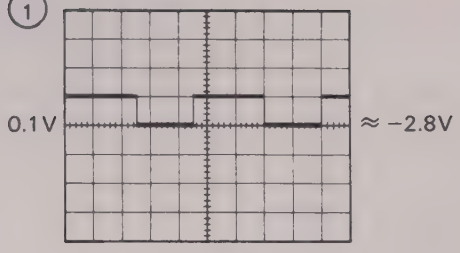

2
0.7V
≈ −0.3V
0.2mS


3
35V
≈ +55V
0.2mS


4
35V
≈ +60V
0.2mS

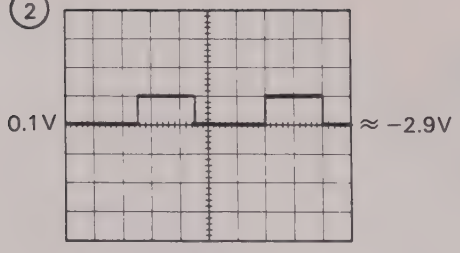

TO 6
J608 Pin 9 (Y-)
J202
L201 2.2μH
C211 1P 500V
R229 220
R230 12K 2W
R237 12K 2W
+160V
+70
Q211 2SC1834
Q215 2SD758C
Q217 2SB718C
Q219 2SA1015Y
R244 160F
R250 22
C213 100P 500V
C219 0.01μ 500V
D212 1S953
D211 1S953
R240 1K
R231 1K
Q212 2SA1015Y
R234 47K 1W
R238 1.8K
D213 RD5.1EB
+12V
Q213 2SA1015Y
R232 1K
C217 0.01μ 500V
C218 0.01μ
R241 1K
D214 1S953
C214 100P 500V
Q216 2SD758C
Q218 2SB718C
Q220 2SA1015Y
C220 0.01μ 500V
Q214 2SC1834
R251 22
R245 160F
+85
R233 12K 2W
R239 12K 2W
C215 2P 500V
C222 3P 500V
L202 2.2μH
R235 220
J203
PB101 (KPN1773)
TO 6
PB601 (Y+)
R225 10
R226 10
-12V
+12V
R209 2.2K
Q209 2SC1815GR
+5.5
R201 1.8K
R253 20K
+3.6
Q201 2SC1815GR
D201 1S953
FROM 1 Q007 Collector
D202 1S953
FROM 3 R324
D203 1S953
FROM 1 Q008 Collector
Q202 2SC1815GR
D204 1S953
-0.7
Q207 2N3905
R210 1.2K
R211 820
R202 2.7K
※A
R207 100
C205 100μ 25V
D209 1S953
R204 2.7K
FROM 3 C310
C221 6P
C209 6P
C208 10P
R218 1.6K
R217 470
R219 470
POS ADJ
R220 1.6K
R252 4.3K
R216 270
R215 1K
Q210 2SC1815GR
R212 820
R213 1.2K
Q208 2N3905
-0.5
R214 2.2K
R205 1.8K
R254 20K
Q203 2SC1815GR
FROM 1 Q107 Collector
※B
C201 0.01μ
D206 1S953
D205 1S953
FROM 3 R323
D207 1S953
Q204 2SC1815GR
FROM 1 Q108 Collector
D208 1S953
Q205 2SC1815GR
C202 0.01μ
Q206 2SC1815GR
R246 22K
R247 22K
R248 100K
S201
CH2 INV.
※A
R249 330
P201
J201
D215 RD5.1EB
D216 TLG102KW
※B Single-Trace only
Dual-Trace only

1



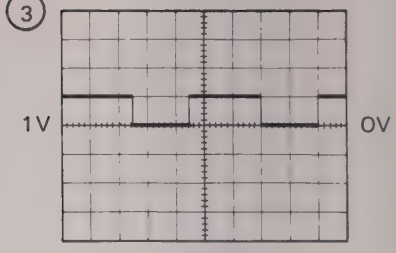
0.2mS
AC COUPLED

2



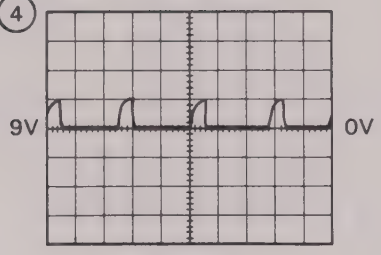
0.2mS
AC COUPLED

3



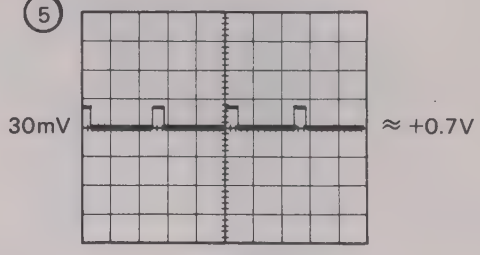
0.2mS

4



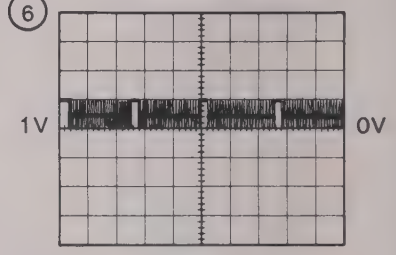
2μS

5



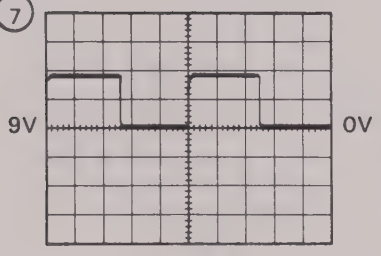
5mS
AC COUPLED

6



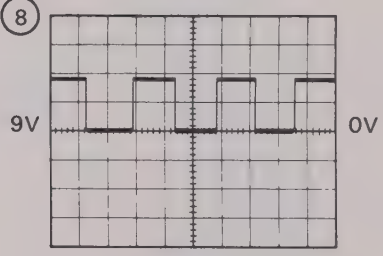
5mS

7



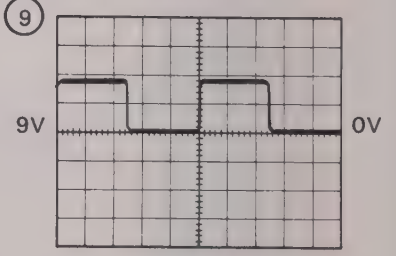
2μS

8



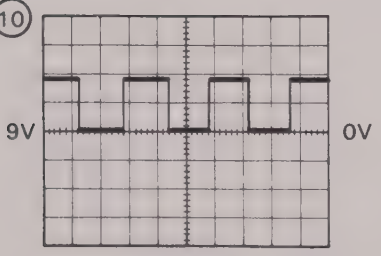
5mS

9

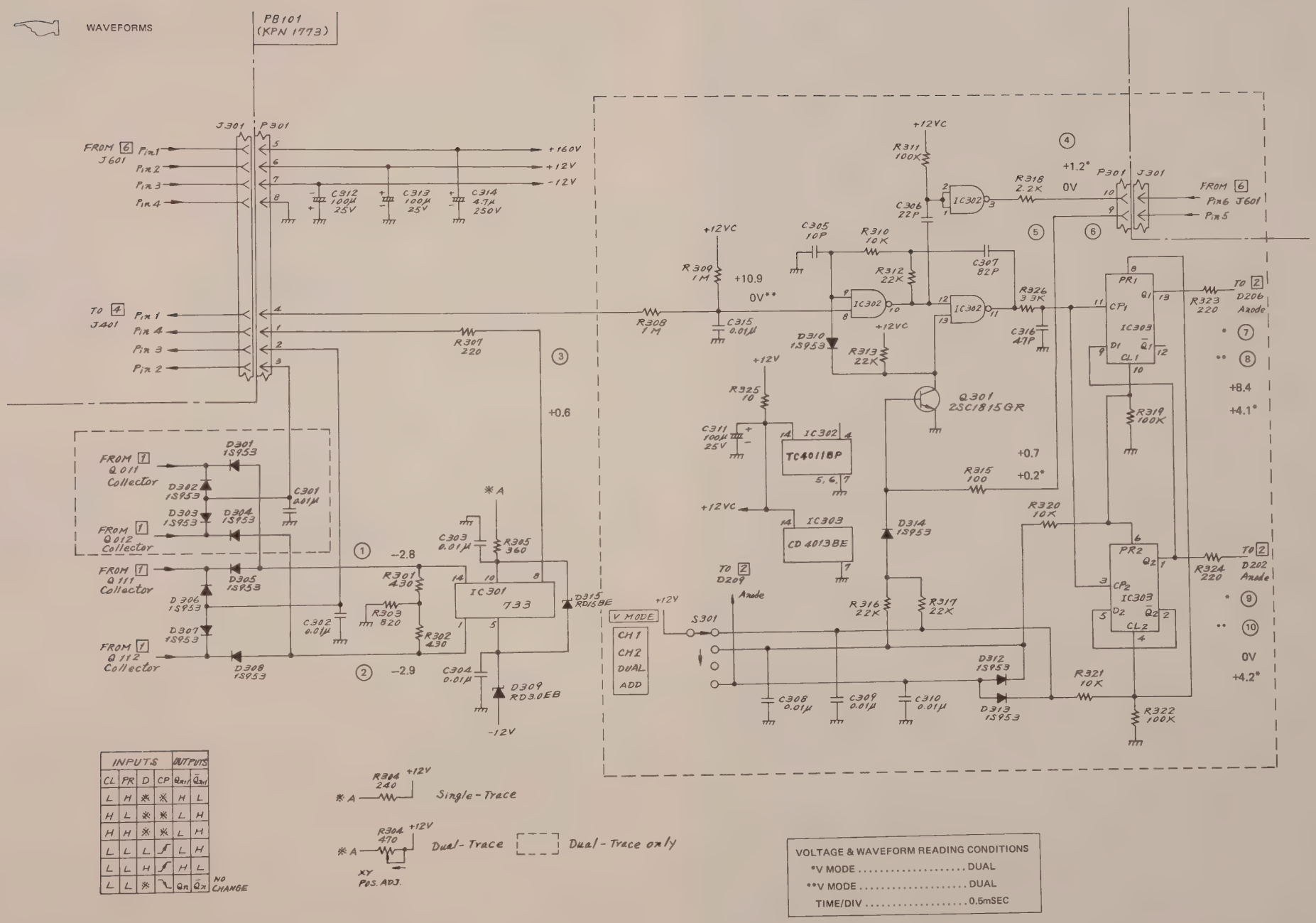


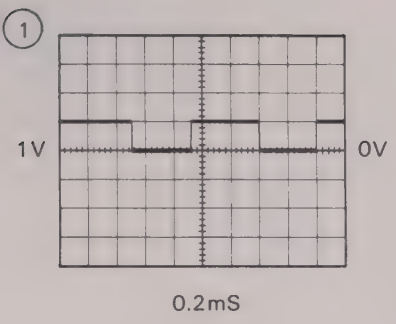
2μS

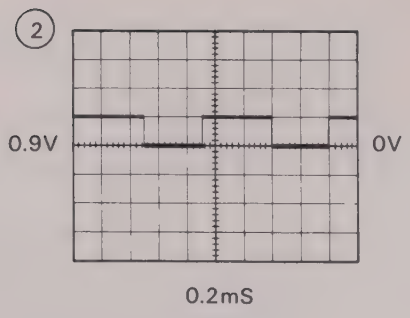
10

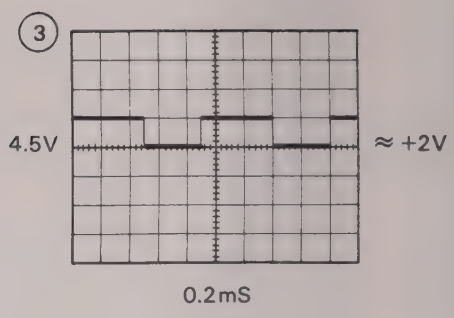


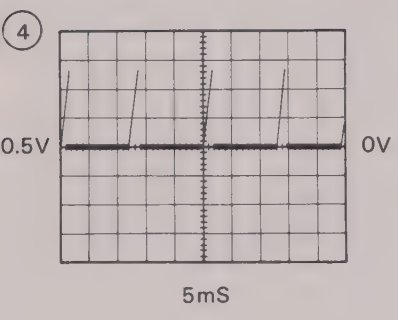
5mS

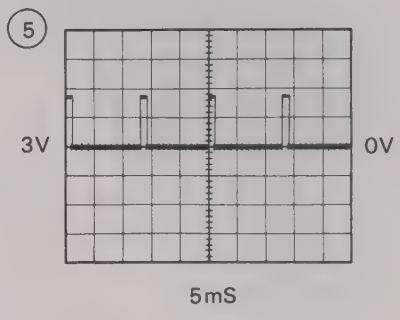

WAVEFORMS
PB101 (KPN 1773)
J301
P301
FROM 6 J601
Pin 1
Pin 2
Pin 3
Pin 4
+160V
+12V
-12V
C312 100μ 25V
C313 100μ 25V
C314 4.7μ 250V
TO 4 J401
R307 220
R308 1M
+0.6
FROM 1 Q011 Collector
FROM 1 Q012 Collector
FROM 1 Q111 Collector
FROM 1 Q112 Collector
D301 1S953
D302 1S953
D303 1S953
D304 1S953
D305 1S953
D306 1S953
D307 1S953
D308 1S953
C301 0.01μ
C302 0.01μ
C303 0.01μ
C304 0.01μ
R301 430
R302 430
R303 820
R305 360
IC301 733
D315 RD5.6E
D309 RD3.0EB
-12V
-2.8
-2.9
*A
R304 240
R304 470
Single-Trace
Dual-Trace
Dual-Trace only
XY POS. ADJ.
+12VC
R309 1M
+10.9
0V**
C315 0.01μ
C305 10P
R310 10K
R312 22K
C307 82P
IC302
D310 1S953
R313 22K
C316 47P
R326 3.3K
R311 100K
C306 22P
R318 2.2K
+1.2*
0V
FROM 6 Pin6 J601
Pin5
TO 2 D206 Anode
R323 220
IC303
R319 100K
+8.4
+4.1*
Q301 2SC1815GR
R325 10
C311 100μ 25V
IC302 TC40118P
R315 100
+0.7
+0.2*
IC303 CD4013BE
D314 1S953
R320 10K
TO 2 D202 Anode
R324 220
R316 22K
R317 22K
TO 2 D209 Anode
V MODE
CH1
CH2
DUAL
ADD
S301
D312 1S953
D313 1S953
C308 0.01μ
C309 0.01μ
C310 0.01μ
R321 10K
R322 100K
0V
+4.2*
INPUTS
OUTPUTS
CL PR D CP Qn+1 Q̄n+1
L H * * H L
H L * * L H
H H * * L H
L L L ∫ L H
L L H ∫ H L
L L * ⌐ Qn Q̄n
NO CHANGE
VOLTAGE & WAVEFORM READING CONDITIONS
*V MODE ..... DUAL
**V MODE ..... DUAL
TIME/DIV 0.5mSEC

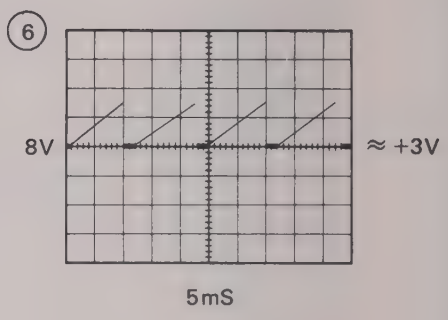

1
1V
0V
0.2mS

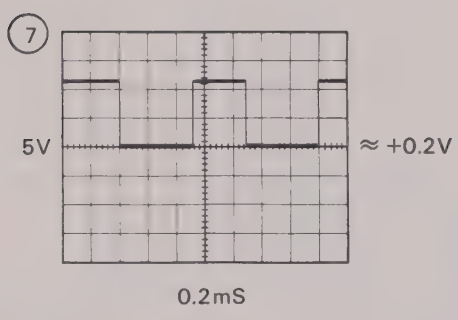

2
0.9V
0V
0.2mS

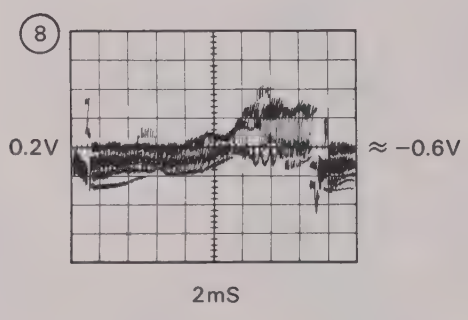

3
4.5V
≈ +2V
0.2mS

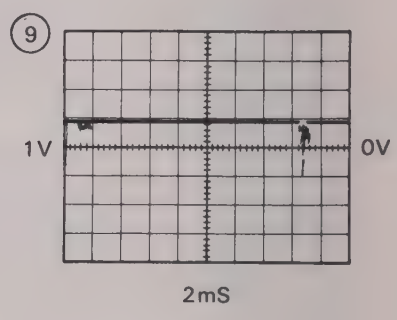

4
0.5V
0V
5mS

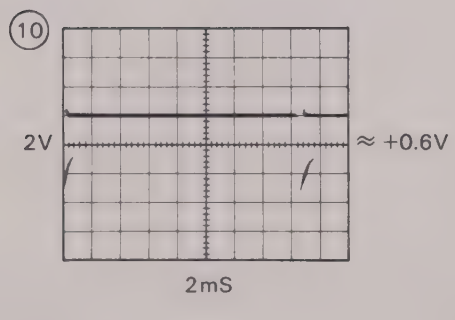

5
3V
0V
5mS

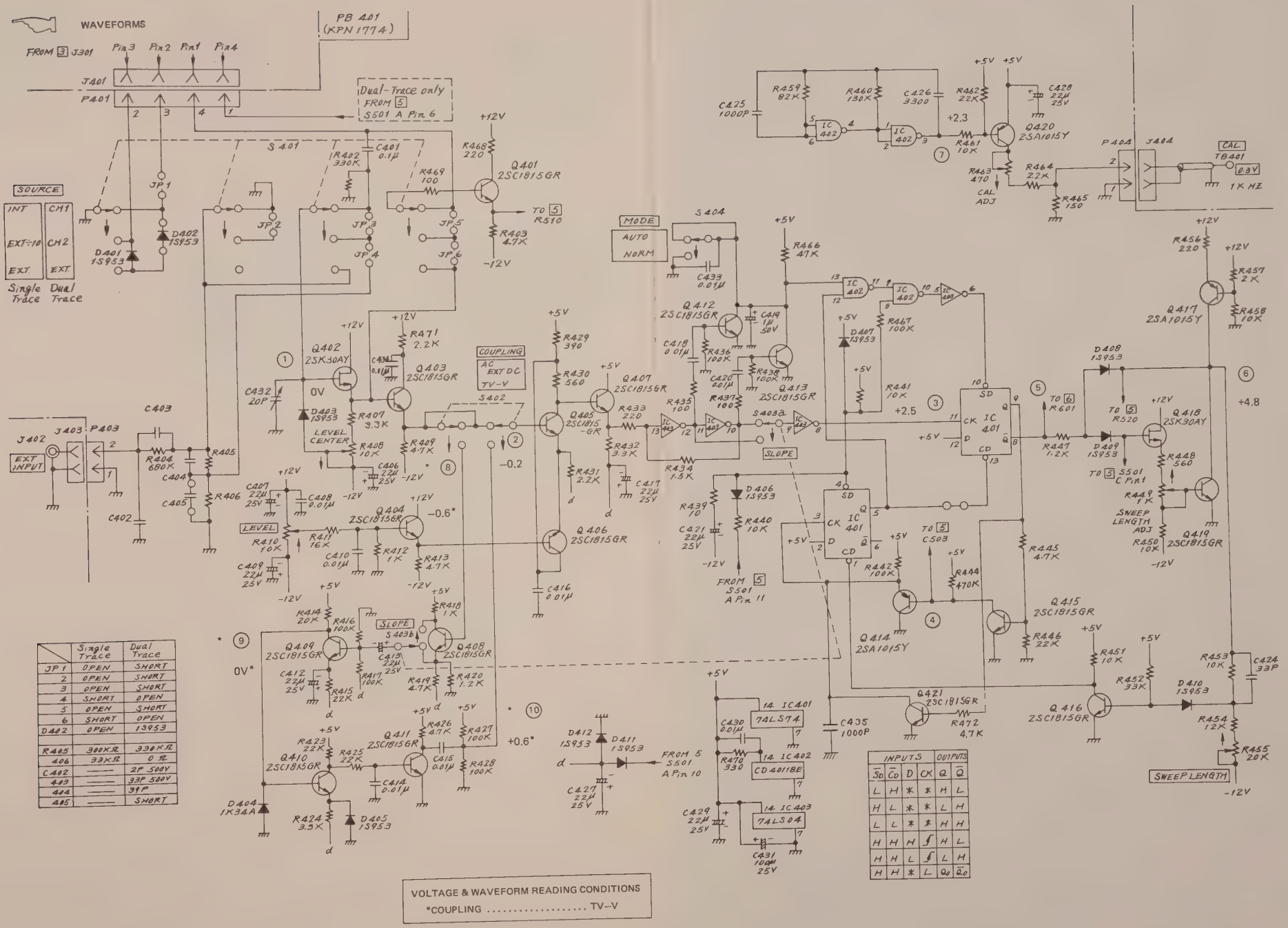

6
8V
≈ +3V
5mS

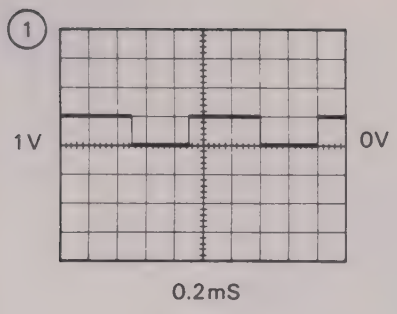

7
5V
≈ +0.2V
0.2mS

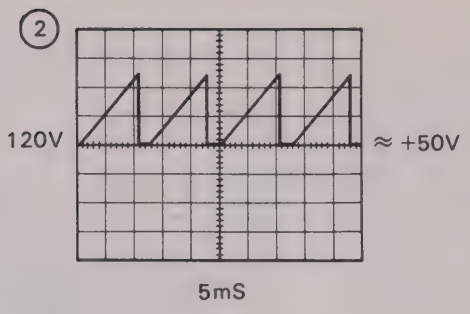

8
0.2V
≈ −0.6V
2mS

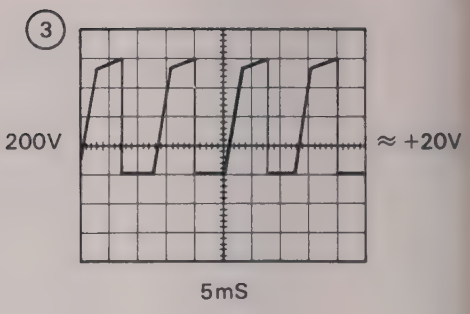

9
1V
0V
2mS

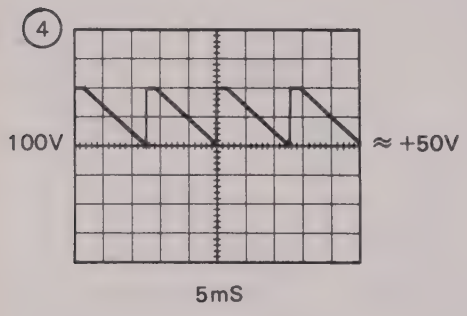

10
2V
≈ +0.6V
2mS

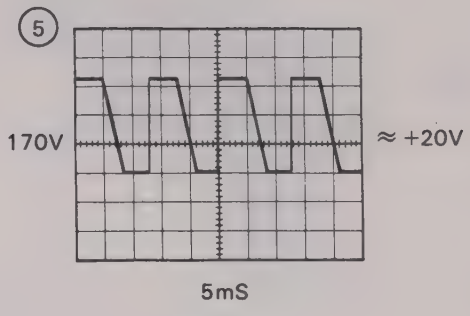

WAVEFORMS
PB 401 (XPN1774)
FROM 9 J301
Pin3 Pin2 Pin1 Pin4
J401
P401
Dual-Trace only FROM 5 S501 A Pin 6
S401
SOURCE
INT CH1
EXT÷10 CH2
EXT. EXT.
Single Trace
Dual Trace
JP1 JP2 JP3 JP4 JP5 JP6
C401 0.1μ
R402 330K
R469 100
R468 220
Q401 2SC1815GR
TO 5 R510
R403 4.7K
+12V
-12V
D401 1S953
D402 1S953
J402
EXT INPUT
J403 P403
C403
R404 680K
R405
C404
C405
R406
C402
Q402 2SK30AY
Q403 2SC1815GR
C432 20P
D403 1S953
LEVEL CENTER
R407 3.3K
R408 10K
R409 4.7K
C406 22μ 25V
0V
COUPLING
AC EXT DC TV-V
S402
-0.2
R471 2.2K
C433 0.01μ
C407 22μ 25V
C408 0.01μ
LEVEL
R410 10K
R411 16K
C409 22μ 25V
Q404 2SC1815GR
-0.6*
C410 0.01μ
R412 1K
R413 4.7K
R429 390
R430 560
Q407 2SC1815GR
Q405 2SC1815-GR
R433 220
R432 3.3K
R431 2.2K
C417 22μ 25V
Q406 2SC1815GR
C416 0.01μ
R434 1.5K
MODE
AUTO NORM
S404
C433 0.01μ
Q412 2SC1815GR
C418 0.01μ
R436 100K
C419 1μ 50V
C420 0.01μ
R437 100K
R438 100K
Q413 2SC1815GR
R435 100
R466 47K
R467 100K
D407 1S953
R441 10K
+2.5
S403a
S403b
SLOPE
R439 10
D406 1S953
R440 10K
C421 22μ 25V
FROM 5 S501 A Pin 11
R445 4.7K
R442 100K
R444 470K
TO 5 C503
Q414 2SA1015Y
Q415 2SC1815GR
R446 22K
R447 1.2K
TO 6 R601
TO 5 R520
D408 1S953
D409 1S953
Q418 2SK30AY
R448 560
R449 1K
SWEEP LENGTH ADJ
R450 10K
Q419 2SC1815GR
TO 5 S501 C Pin1
+4.8
R456 220
R457 2K
R458 10K
Q417 2SA1015Y
R459 82K
R460 130K
C425 1000P
C426 3300
R462 22K
C428 22μ 25V
+2.3
R461 10K
Q420 2SA1015Y
R463 470
CAL ADJ
R464 2.2K
R465 150
P404 J404
CAL TB401
0.3V 1K HZ
Q421 2SC1815GR
R472 4.7K
C435 1000P
Q416 2SC1815GR
R451 10K
R452 33K
D410 1S953
R453 10K
C424 33P
R454 12K
R455 20K
SWEEP LENGTH
R414 20K
R416 100K
Q409 2SC1815GR
C412 22μ 25V
R415 22K
R417 100K
C413 22μ 25V
R418 1K
Q408 2SC1815GR
R419 4.7K
R420 1.2K
0V*
+0.6*
R423 22K
R425 22K
Q410 2SC1815GR
R426 4.7K
Q411 2SC1815GR
R427 100K
C415 0.01μ
R428 100K
C414 0.01μ
R424 3.5K
D404 1K34A
D405 1S953
D412 1S953
D411 1S953
FROM 5 S501 A Pin 10
C427 22μ 25V
IC 401 74LS74
IC 402 CD4011BE
IC 403 74LS04
C429 22μ 25V
C430 0.01μ
R470 330
C431 100μ 25V
INPUTS SD CD D CK
OUTPUTS Q Q̄
L H * * H L
H L * * L H
L L * * H H
H H H ∫ H L
H H L ∫ L H
H H * L Q0 Q̄0
Single Trace Dual Trace
JP1 OPEN SHORT
2 OPEN SHORT
3 OPEN SHORT
4 SHORT OPEN
5 OPEN SHORT
6 SHORT OPEN
D402 OPEN 1S953
R405 300KΩ 330KΩ
406 33KΩ 0Ω
C402 —— 2P 500V
403 —— 33P 500V
404 —— 39P
405 —— SHORT
VOLTAGE & WAVEFORM READING CONDITIONS
*COUPLING ..... TV-V

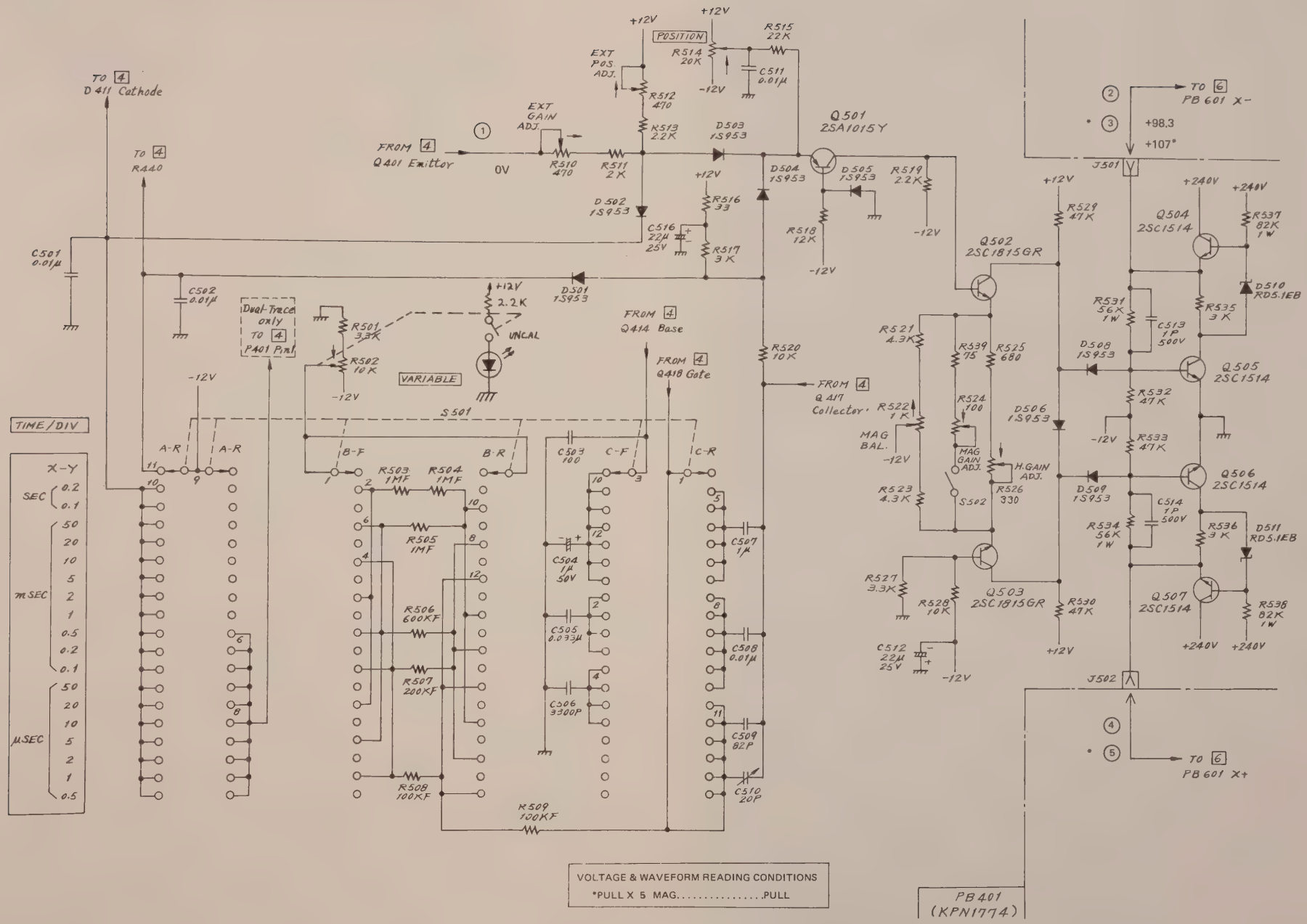

1
1V
0V
0.2mS

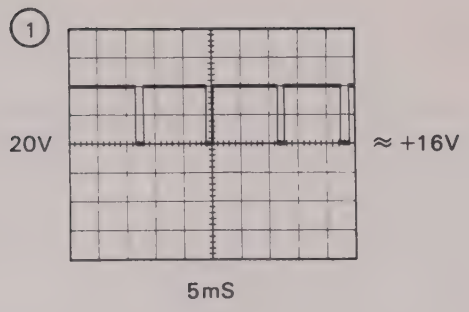

2
120V
≈ +50V
5mS

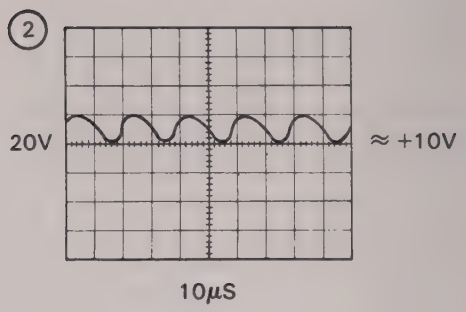

3
200V
≈ +20V
5mS


4
100V
≈ +50V
5mS

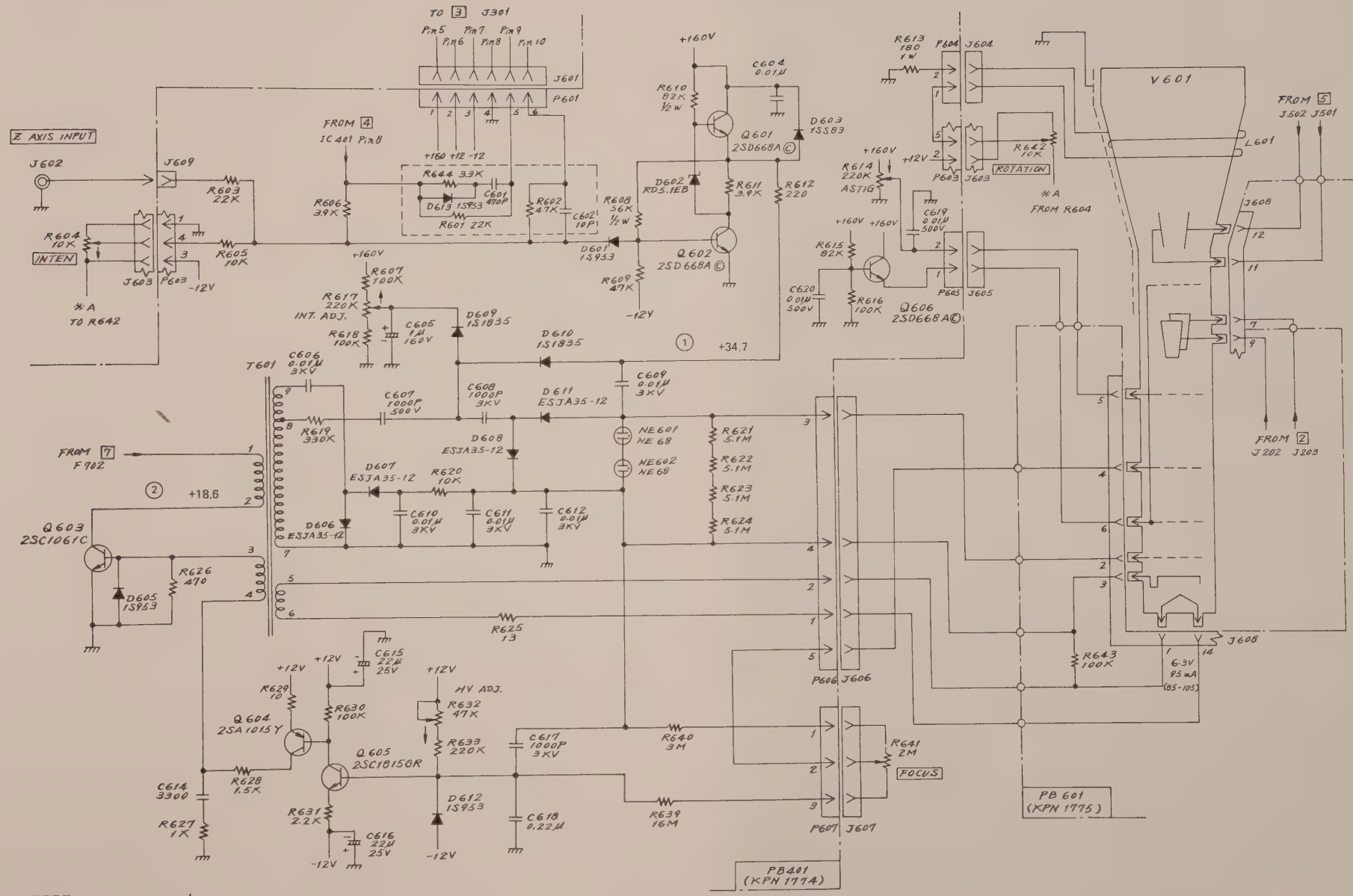

5
170V
≈ +20V
5mS

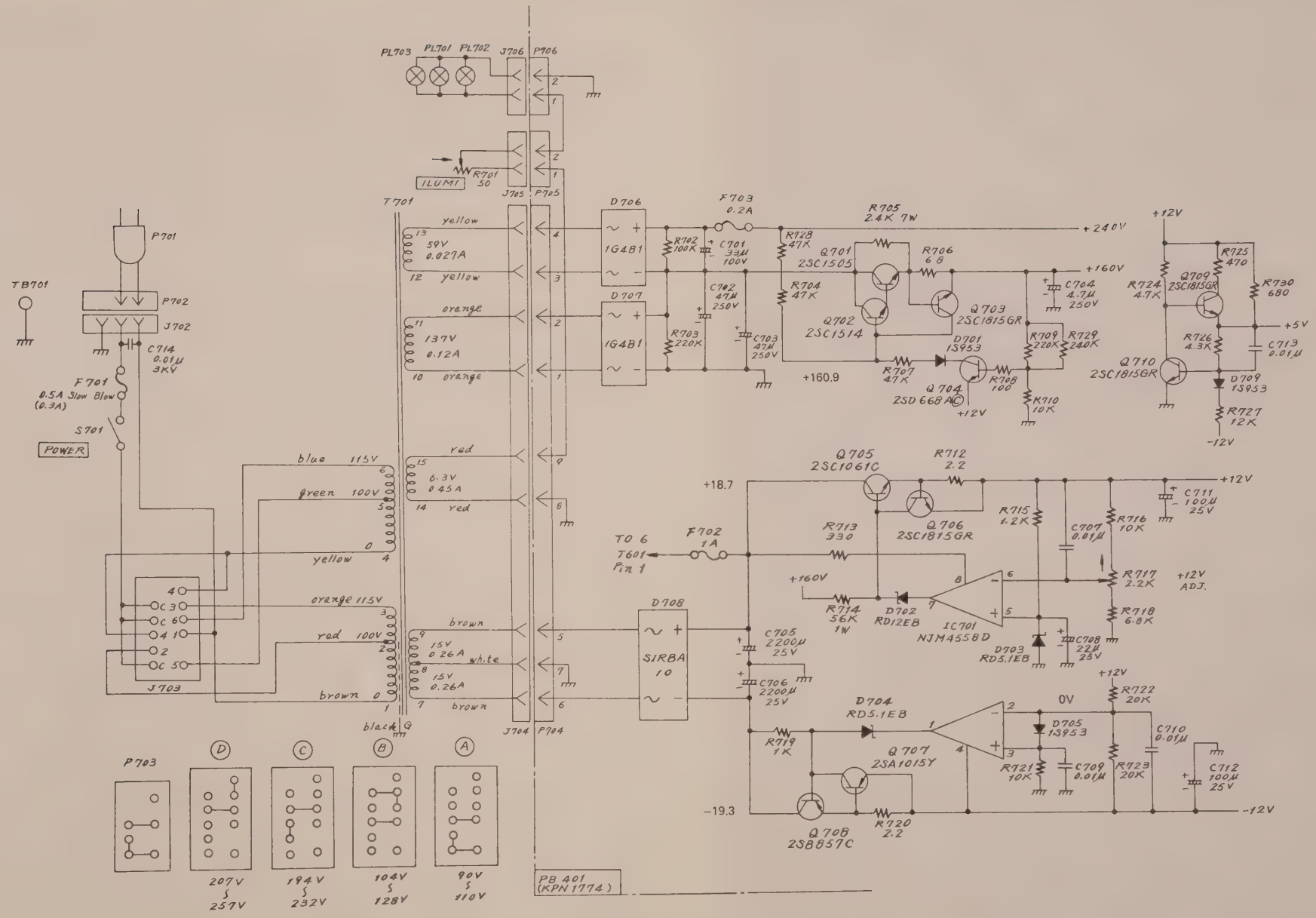

TO 4 D411 Cathode
TO 4 R440
FROM 4 Q401 Emitter
0V
EXT GAIN ADJ.
EXT POS. ADJ.
POSITION
+12V
-12V
R515 22K
R514 20K
C511 0.01μ
R512 470
R513 2.2K
R510 470
R511 2K
D503 1S953
Q501 2SA1015Y
D502 1S953
D504 1S953
D505 1S953
R519 2.2K
R518 12K
R516 33
C516 22μ 25V
R517 3K
C501 0.01μ
C502 0.01μ
D501 1S953
Dual-Trace only TO 4 P401 Pin1
R501 3.3K
R502 10K
VARIABLE
UNCAL
2.2K
FROM 4 Q414 Base
FROM 4 Q418 Gate
FROM 4 Q417 Collector
R520 10K
S501
TIME/DIV
X-Y
SEC
mSEC
μSEC
A-R
B-F
B-R
C-F
C-R
R503 1MF
R504 1MF
R505 1MF
R506 600KF
R507 200KF
R508 100KF
R509 100KF
C503 100
C504 1μ 50V
C505 0.033μ
C506 3300P
C507 1μ
C508 0.01μ
C509 82P
C510 20P
Q502 2SC1815GR
Q503 2SC1815GR
R521 4.3K
R522 1K
R523 4.3K
R524 100
R525 680
R526 330
R527 3.3K
R528 10K
R529 47K
R530 47K
R539 75
MAG BAL.
MAG GAIN ADJ.
H.GAIN ADJ.
S502
C512 22μ 25V
Q504 2SC1514
Q505 2SC1514
Q506 2SC1514
Q507 2SC1514
R531 56K 1W
R532 47K
R533 47K
R534 56K 1W
R535 3K
R536 3K
R537 82K 1W
R538 82K 1W
C513 1P 500V
C514 1P 500V
D508 1S953
D509 1S953
D506 1S953
D510 RD5.1EB
D511 RD5.1EB
+240V
J501
J502
TO 6 PB601 X-
TO 6 PB601 X+
+98.3
+107*
VOLTAGE & WAVEFORM READING CONDITIONS
*PULL X 5 MAG.....PULL
PB401 (KPN1774)


1
20V
≈ +16V
5mS


2
20V
≈ +10V
10μS

WAVEFORMS


Z AXIS INPUT
J602
J609
R603 22K
R604 10K
INTEN
R605 10K
J603
P603
-12V
*A TO R642
FROM 4 IC401 Pin8
+16V +12 -12
R644 3.3K
C601 470P
D613 1S953
R601 22K
R606 3.9K
R602 4.7K
C602 10P
TO 3 J301
Pin5 Pin7 Pin9
Pin6 Pin8 Pin10
J601
P601
+160V
R610 82K 1/2W
C604 0.01μ
Q601 2SD668A©
D603 1SS83
D602 RD5.1EB
R611 3.9K
R612 220
R608 56K 1/2W
D601 1S953
Q602 2SD668A©
R609 47K
-12V
R607 100K
R617 220K INT. ADJ.
R618 100K
C605 1μ 160V
D609 1S1835
D610 1S1835
C606 0.01μ 3KV
T601
C607 1000P 500V
C608 1000P 3KV
D611 ESJA35-12
C609 0.01μ 3KV
R619 330K
D608 ESJA35-12
D607 ESJA35-12
R620 10K
C610 0.01μ 3KV
C611 0.01μ 3KV
C612 0.01μ 3KV
D606 ESJA35-12
FROM 7 F702
+18.6
Q603 2SC1061C
R626 470
D605 1S953
R625 13
NE601 NE68
NE602 NE68
R621 5.1M
R622 5.1M
R623 5.1M
R624 5.1M
+34.7
R613 180 1W
P604 J604
V601
FROM 5 J502 J501
L601
R642 10K
ROTATION
*A FROM R604
+160V +12V
R614 220K ASTIG
C619 0.01μ 500V
J608
R615 82K
C620 0.01μ 500V
R616 100K
Q606 2SD668A©
P605 J605
FROM 2 J202 J203
R643 100K
6.3V 95mA (85-105)
P606 J606
C615 22μ 25V
R629 10
R630 100K
HV ADJ.
R632 47K
Q604 2SA1015Y
R633 220K
Q605 2SC1815GR
C617 1000P 3KV
R640 3M
R641 2M
FOCUS
C614 3300
R628 1.5K
R627 1K
R631 2.2K
C616 22μ 25V
D612 1S953
C618 0.22μ
R639 16M
P607 J607
PB601 (KPN1775)
PB401 (KPN1774)
Dual Trace only


PL703
PL701
PL702
J706
P706
ILUMI
R701 50
J705
P705
T701
D706
D707
1G4B1
F703 0.2A
R705 2.4K 7W
+240V
+160V
+160.9
R702 100K
C701 33μ 100V
R703 220K
C702 47μ 250V
C703 47μ 250V
R728 47K
R704 47K
Q701 2SC1505
Q702 2SC1514
R706 6.8
Q703 2SC1815GR
C704 4.7μ 250V
R709 220K
R729 240K
D701 1S953
R707 47K
Q704 2SD 668A
R708 100
R710 10K
+12V
R725 470
Q709 2SC1815GR
R730 680
R724 4.7K
+5V
R726 4.3K
C713 0.01μ
Q710 2SC1815GR
D709 1S953
R727 12K
-12V
P701
TB701
P702
J702
C714 0.01μ 3KV
F701 0.5A Slow Blow (0.3A)
S701
POWER
yellow
59V 0.027A
yellow
orange
137V 0.12A
orange
red
6.3V 0.45A
red
blue 115V
green 100V
yellow
orange 115V
red 100V
brown
15V 0.26A
white
15V 0.26A
brown
black
J703
J704
P704
D708
SIRBA 10
C705 2200μ 25V
C706 2200μ 25V
TO 6 T601 Pin 1
F702 1A
+18.7
Q705 2SC1061C
R712 2.2
Q706 2SC1815GR
R713 330
R714 56K 1W
D702 RD12EB
IC701 NJM4558D
R715 1.2K
C707 0.01μ
R716 10K
R717 2.2K
+12V ADJ.
R718 6.8K
C708 22μ 25V
D703 RD5.1EB
C711 100μ 25V
+12V
0V
D704 RD5.1EB
R719 1K
Q707 2SA1015Y
D705 1S953
R721 10K
C709 0.01μ
R722 20K
R723 20K
C710 0.01μ
C712 100μ 25V
-19.3
Q708 2SB857C
R720 2.2
-12V
P703
D
C
B
A
207V ~ 257V
194V ~ 232V
104V ~ 128V
90V ~ 110V
PB 401 (KPN 1774)

ELECTRICAL PARTS LIST

SECTION 4

ORDERING INFORMATION

Replacement parts may be ordered through an ECI representative or directly from the factory. To be certain of receiving the proper parts, always include the following information with the order.

a. Model Number and serial number of the instrument on which the parts will be installed.
b. Circuit reference number and subassembly name, if applicable, for which the part is intended. If the part does not have a circuit reference, the description from the parts list should be used.
c. ECI part number.

For factory repair, contact the ECI agent and include the following information.

a. Model number and serial number of the instrument on which the work is to be performed.
b. Details concerning the nature of the malfunction, or, type of repair desired.
Shipping instructions will be sent to you promptly.

HOW TO USE THIS PARTS LIST

The parts list is divided into subsections corresponding to the schematic diagrams such as Attenuator & Vertical Pre-amplifier, Vertical Main amplifier, Trigger Amplifier & Vertical MODE Control, Trigger Generator & Sweep Generator, Timing & Horizontal Amplifier, Z Amplifier & CRT Circuit and Power Supply. Component locations can be determined from the schematic diagrams, each component appears only once in the parts list. At the beginning of each subsection are listed part numbers for any complete subassemblies in that category that are available as replacement parts. These subassemblies may include individually-listed components; care should be taken to locate malfunctions to the lowest possible level of replacement part and thus avoid the time and cost involved in "over-repair."

ABBREVIATIONS

Cap . . . . . Capacitor
  Cer . . . . . Ceramic
  Poly . . . . . Polyester film
  Elect. . . . . Aluminum electrolytic chemical condenser
  Elect. tan, ... Tan-talum electrolytic chemical condenser
  [The symbol of F (farad) is omitted]
Res. . . . . Resistor
  W.W. . . . . Wire wound
  Compo . . . . . Composition
  [The symbol of Ω (ohm) is omitted]
FET . . . . . Field Effect Transistor
Diode
  T.diode . . . . . Tunnel diode
  Z.diode . . . . . Zenner diode
  S.B. diode Schottky barrier diode
  V.C. diode . . . . . Variable capacitance diode
  L.E.D. . . . . Light emission diode
Var. . . . . Variable

CKT. NO.	DESCRIPTION	ECI PART NO.
ATTENUATOR & VERTICAL PRE-AMPLIFIER		
C001/101	Cap., 0.0473μ,±0.5%, 400V, Film	DCF168011
C002/102	Cap., 4p, ±0.5p, 500V, Cer.	DCC250801
C003/103	Cap., 12p, Var., 250V, Cer.	DCV019701
C004/104	Cap., 8p, Var., 250V, Cer.	DCV019691
C005/105	Cap., 8.2p, ±5%, 100V, Cer.	DCC246511
C006/106	Same as C004	
C007/107	Same as C003	
C008/108	Cap., 470p, ±10%, 50V, Cer.	DCC237481
C009/109	Same as C004	
C010/110	Cap., 22.5p, Var., 250V, Cer.	DCV019711
C011/111	Cap., 4.700p, ±5%, 50V, Styrol	DCF127311
C012/112	Cap., 1,000p, ±10%, 500V, Cer.	DCC151811
C013/113	Cap., 22μ,−10~+100%, 25V, Elect.	DCE225151
C015/115	Same as C013	
C016/116	Cap., 0.001μ, −20~+80%, 50V, Cer.	DCC132571
C017/117	Same as C013	
C018/118	Cap., 18p, ±5%, 50V, Cer.	DCC232201
C019/119	Cap., 7p, ±0.5p, 50V, Cer.	DCC231101
C020/120	Cap., 2p, ±0.25p, 50V, Cer.	DCC230501
C021/121	Same as C016	
C022/122	Cap., 82p, ±5%, 50V, Cer.	DCC233801
C023/123	Same as C022	
C024/124	Same as C020	
C025/125	Same as C004	
C026/126	Cap., 1,00p, ±10%, 50V, Film	DCF120111
C027/127	Cap., 10p, ±0.5p, 50V, Cer.	DCC231701
C028/128	Cap., 47μ,−10~+150V, 25V, Elect.	DCE225171
C029/129	Same as C028	
C030/130	Same as C026	
C031/131	Cap., 3p, ±0.25p, 50V, Cer.	DCC230701
C032	Same as C031	
C132	Same as C020	
R001/101	Res., 10, ±5%, ¼W, Carbon	DRD134351
R002/102	Res., 900k, ±1%, ¼w, Metal	DRE139821
R003/103	Res., 111k, ±1%, ¼W, Metal	DRE132641
R004/104	Res., 990k, ±1%, ¼W, Metal	DRE139831
R005/105	Res., 10.1k, ±1%, ¼W, Metal	DRE132631
R006/106	Res., 999k, ±1%, ¼W, Metal	DRE139841
R007/107	Res., 1k, ±1%, ¼W, Metal	DRE130831
R008/108	Res., 1M, ±1%, ¼W, Metal	DRE139851
R009/109	Res., 470k, ±1%, ¼W, Metal	DRE135471
R010/110	Res., 470, ±5%, ¼W, Carbon	DRD134751
R011/111	Res., 100, ±5%, ¼W, Carbon	DRD134591
R012/112	Res., 75, ±5%, ¼W, Carbon	DRD134561

CKT.NO.	DESCRIPTION	ECI PART NO.
R013/113	Res., B100, Var., 0.5W, Metal	DRV430541
R014/114	Same as R011	
R015/115	Same as R010	
R016/116	Res., 3.9k, ±5%, ¼W, Carbon	DRD134971
R017/117	Res., 10k, ±5%, ¼W, Carbon	DRD135071
R018/118	Same as R017	
R019/119	Same as R001	
R020/120	Res., 1.6k, ±5%, ¼W, Carbon	DRD134881
R021/121	Res., 820, ±1%,¼W, Metal	DRE130811
R022/122	Res., 4.3k, ±1%, ¼W, Metal	DRE130981
R023/123	Same as R022	
R024/124	Same as R021	
R025/125	Res., 5.6k, ±5%, ¼W, Carbon	DRD135011
R026/126	Res., 560, ±1%, ¼W, Metal	DRE130771
R027/127	Res., 12k, ±5%, ¼W, Carbon	DRD135091
R028/128	Res., 1.8k, ±1%, ¼W, Metal	DRE130891
R029/129	Res., 2k, ±1%, ¼W, Metal	DRE130901
R030/130	Same as R007	
R031/131	Res., 200,±1%, ¼W, Metal	DRE130661
R032/132	Res., B1k, Var., 0.1W, Metal	DRV147281
R033/133	Same as R031	
R034/134	Res., 2.7k, ±5%, ¼W, Carbon	DRD134931
R035/135	Res., B470, Var., 0.5W, Metal	DRV430561
R036/136	Res., 3k, ±5%, ¼W, Carbon	DRD134941
R037/137	Same as R007	
R038/138	Res., 390, ±5%, ¼W, Carbon	DRD134731
R039/139	Same as R029	
R040/140	Res., 1.5k, ±5%, ¼W, Carbon	DRD134871
R041/141	Res., B1k, Var., 0.5W, Carbon	DRV430571
R042/142	Same as R029	
R043/143	Same as R029	
R044/144	Same as R007	
R045/145	Res., 510, ±1%, ¼W, Metal	DRE130761
R046/146	Res., 470, ±1%, ¼W, Metal	DRE130751
R047/147	Same as R016	
R048/148	Same as R016	
R049/149	Res., 220k, ±5%, ¼W, Carbon	DRD135391
R051/151	Same as R040	
R052/152	Res., 4.7k, ±5%. ¼W, Carbon	DRD134991
R053/153	Same as R052	
R054/154	Same as R011	
R055/155	Same as R052	
R056/156	Same as R052	
R057/157	Same as R011	
R058/158	Same as R035	
R059/159	Same as R034	
R060/160	Res., 4.3k, ±5%, ¼W, Carbon	DRD134981

CKT. NO.	DESCRIPTION	ECI PART NO.
R061/161	Same as R060	
R062/162	Same as R001	
R063/163	Same as R001	
R064/164	Res., 22, ±5%, ¼W, Carbon	DRD134431
R065/165	Res., 220k, ±5%, ¼W, Carbon	DRD238391
R066/166	Same as R040	
R067/167	Res., B100, Var., 0.5W, Metal	DRV430541
R068/168	Res., 220, ±5%, ¼W, Carbon	DRD134671
Q001/101	FET, 2SK30A-Y	DTR210141
Q002/102	FET, μPA61AM	DTR295281
Q003/103	Transistor, 2SA1015Y	DTR116111
Q004/104	Same as Q003	
Q005/105	Transistor, 2SC1815GR	DTR137781
Q006to 012/106 to 112	Same as Q005	
IC001/101	IC(Transistors Array), HA1127	DTR190631
P002/102	Connector. M36-02-30-114P	DCN034851
P003/103	Connector, M33-05-30-114P	DCN034671
J001/101	Connector, BNC080	DCN040711
J002/102	Connector, M36•M87-02	DCN034601
	M31•C8-4	DCN034951
J003/103	Connector, M33•M87-05	DCN034581
S001/101	Slide-switch, SLEP223C-F	DSW055741
S002/102	Rotary-switch, PS22BH 3-3-11/RV	DTA020501
TB101	Terminal, 8φ (GND)	DTA020501

CKT.NO.	DESCRIPTION	ECI PART NO.
VERTICAL MAIN AMPLIFIER		
C201	Cap., 0.01μ, −20~+80%, 50V, Cer.	DCC133571
C202	Same as C201	
C205	Cap., 100μ, −10~+100V, 250V, Elect.	DCE225181
C208	Cap., 5p, ±0.25p, 50V, Cer.	DCC230901
C209	Cap., 8p, Var., 250V, Cer.	DCV019691
C211	Cap., 10p, ±0.25p, 500V, Cer.	DCC250301
C213	Cap., 100p, ±10%, 500V, Cer.	DCC254031
C214	Same as C213	
C215	Same as C211	
C217	Cap., 0.01μ, ±10%, 500V, Cer.	DCC153501
C218	Cap., 0.01μ,±10%, 50V, Cer.	DCC133571
C219	Same as C217	
C220	Same as C217	
L201	Inductance, LF8-2R2K	DCL110911
L202	Same as L201	
R201	Res., 1.2k, ±5%, ¼W, Carbon	DRD134851
R202	Res., 2.7k, ±5%, ¼W, Carbon	DRD134931
R204	Same as R202	
R205	Same as R201	
R207	Res., 100, ±5%, ¼W, Carbon	DRD134591
R209	Res., 2.2k, ±5%, ¼W, Carbon	DRD134911
R210	Res., 1.2k, ±5%, ¼W, Carbon	DRD134851
R211	Res., 820, ±5%, ¼W, Carbon	DRD134811
R212	Same as R211	
R213	Same as R210	
R214	Same as R209	
R215	Res., 1k, ±5%, ¼W, Carbon	DRD134831
R216	Res., 270, ±5%, ¼W, Carbon	DRD134691
R217	Res., 470, ±5%, ¼W, Carbon	DRD134751
R218	Same as R201	
R219	Res., B100, Var., 0.5W, Metal	DRV430541
R220	Same as R201	
R225	Res., 10, ±5%, ¼W, Metal	DRD134351
R226	Same as R225	
R229	Res., 220, ±5%, ¼W, Carbon	DRD134671
R230	Res., 12k, ±5%, 2W, Metal	DRS130561
R231	Same as R215	
R232	Same as R215	
R233	Same as R230	
R234	Res., 47k, ±5%, 1W, Metal	DRS120631
R235	Same as R229	
R237	Same as R230	
R238	Same as R201	
R239	Same as R230	
R240	Same as R215	
R241	Same as R215	
R244	Res., 160, ±1%, ¼W, Metal	DRE130641
R245	Same as R244	
R246	Res., 22k, ±5%, ¼W, Carbon	DRD135151
R247	Same as R246	
R248	Res., 100k, ±5%, ¼W, Carbon	DRD135311
R249	Res., 330. ±5%, ¼W, Carbon	DRD134711
R250	Res., 22, ±5%, ¼W, Carbon	DRD134431
R251	Same as R250	
D201	Diode, 1S953	DDD010051
D202 to D209	Same as D201	
D211	Same as D201	
D212	Same as D201	
D213	Z・Diode, RD5.1EB	DDD030571
D214	Same as D201	
D215	Same as D213	
D216	LED, TLG102KW	DDD070931
Q201 to Q206	Transistor, 2SC1815GR	DTR137781
Q207	Transistor, 2N3905	DTR150011
Q208	Same as Q207	
Q209	Same as Q201	
Q210	Same as Q201	
Q211	Transistor, 2SC1834	DTR131031
Q212	Transistor, 2SA1015Y	DTR116111
Q213	Same as Q212	
Q214	Same as Q211	
Q215	Transistor, 2SD758C	DTR145161
Q216	Same as Q215	
Q217	Transistor, 2SB718C	DTR125241
Q218	Same as Q217	
Q219	Same as Q212	
Q220	Same as Q212	
P201	Connector, M36-02-30-114P	DCN034851

CKT.NO.	DESCRIPTION	ECI PART NO.
J201	Connector, M36・M87-02	DCN034601
	Connector, M31・C8-4	DCN034951
J202	Wire-post, WP22-1B	DCN033821
J203	Same as J202	
S201	Push-switch, SPJ222N	DSW014961
TRIGGER AMPLIFIER & VERTICAL MODE CONTROL		
C301 to C304		
	Cap., 0.01μ,−20~+80%, 50V, Cer.	DCC133571
C305	Cap., 10p, ±0.5p, 50V, Cer.	DCC231701
C306	Cap., 15p, ±5%, 50V, Cer.	DCC232011
C307	Cap., 82p, ±5%, 50V, Cer.	DCC233801
C308 to 310		
	Same as C301	
C311 to C313		
	Cap., 100μ, −10~+100%, 25V, Elect.	DCE225181
C314	Cap., 4.7μ, −10~+100%, 250V, Elect.	DCE270401
C315	Same as C301	
C316	Cap., 470, ±5%, 50V, Cer.	DCC233201
R301	Res., 430, ±5%, ¼W, Carbon	DRD134741
R302	Same as R301	
R303	Res., 820,±5%, ¼W, Carbon	DRD134811
R304	Res., B470, Var., 0.5W, Metal	DRV430561
R305	Res., 360, ±5%, ¼W, Carbon	DRD134721
R307	Res., 220, ±5%, ¼W, Carbon	DRD134671
R308	Res., 1M, ±5%, ¼W, Carbon	DRD135551
R309	Same as R308	
R310	Res., 10k, ±5%, ¼W, Carbon	DRD135071
R311	Res., 100k, ±5%, ¼W, Carbon	DRD135311
R312	Res., 22k, ±5%, ¼W, Carbon	DRD135151
R313	Same as R312	
R315	Res., 100, ±5%, ¼W, Carbon	DRD134591
R316	Res., 47k,±5%, ¼W, Carbon	DRD135231
R317	Same as R316	
R318	Res., 2.2k, ±5%, ¼W, Carbon	DRD134911
R319	Same as R311	
R320	Same as R310	
R321	Same as R310	
R322	Same as R311	
R323	Res., 220,±5%, ¼W, Carbon	DRD134671
R324	Same as R323	
R325	Res., 10, ±5%, ¼W, Carbon	DRD134351
R326	Res., 3.3k, ±5%, ¼W, Carbon	DRD134951
D301 to 308		
	Diode, 1S953	DDD010051
D309	Z. Diode, RD3.0EB	DDD030621
D310	Same as D301	
D312 to 314		
	Same as D301	
D315	Z. Diode, RD15EB	DDD030351
Q301	Transistor, 2SC1815GR	DTR137781
IC301	IC,UA733CN(Video-Amp.)	DIC623081
IC302	IC, CD4011BE	DIC410101
IC303	IC, CD4013BE	DIC410121
P301	Connector, M33-10-30-114P	DCN034721
J301	Connector, M31・M87-10	DCN034531
	M31・C8-4	DCN034951
S301	Lever-switch, SLR024	DSW045011
TRIGGER GENERATOR & SWEEP GENERATOR		
C401	Cap., 0.1μ ±10%, 50V, Film	DCF120351
C402	Cap., 2p, ±0.25p, 500V, Cer.	DCC250501
C403	Cap., 33p, ±10%, 500V, Cer.	DCC252801
C404	Cap., 56p, ±5%, 50V, Cer.	DCC233401
C406	Cap., 22μ, −10~+100%, 25V, Elect.	DCE225151
C407	Same as C406	
C408	Cap., 0.01μ, −20~+80%, 50V, Cer.	DCC133571
C409	Same as C406	
C410	Same as C408	

CKT.NO	DESCRIPTION	ECI PART NO.
C412	Same as C406	
C413	Same as C406	
C414 to 416		
	Same as C408	
C417	Same as C406	
C418	Same as C408	
C419	Cap., 1μ, −10~+100%, 50V, Elect.	DCE245021
C420	Same as C408	
C421	Same as C406	
C424	Cap., 33p, ±5%, 50V, Cer.	DCC232801
C425	Cap., 1,000μ,±10%, 50V, Film	DCF120111
C426	Cap., 3,300μ, ±10%, 50V, Film	DCF120171
C427 to 429		
	Same as C406	
C430	Same as C408	
C431	Cap., 100μ, −10~+100%, 25V, Elect.	DCE225181
C432	Cap., 8p, Var., 250V, ±200ppM/°C, Cer.	DCV019691
R402	Res., 330k, ±5%, ¼W, Carbon	DRD135431
R403	Res., 4.7k, ±5%, ¼W, Carbon	DRD134991
R404	Res., 680k, ±5%, ¼W, Carbon	DRD135511
R405	Same as R402	
R407	Res., 3.9k, ±5%, ¼W, Carbon	DRD134991
R408	Res., B10k, Var., 0.5W, Metal	DRV430591
R409	Same as R403	
R410	Res., B10k, Var., 0.1W, Carbon Ganged with S403a, b	DRV147311
R411	Res., 16k, ±5%, ¼W, Carbon	DRD135121
R412	Res., 1k, ±5%, ¼W, Carbon	DRD134831
R413	Same as R403	
R414	Res., 20k, ±5%, ¼W, Carbon	DRD135141
R415	Res., 22k, ±5%, ¼W, Carbon	DRD135151
R416	Res., 100k, ±5%, ¼W, Carbon	DRD135311
R417	Same as R416	
R418	Same as R412	
R419	Same as R403	
R420	Res., 1.2k, ±5%, ¼W, Carbon	DRD134851
R423	Same as R415	
R424	Res., 3.3k, ±5%, ¼W, Carbon	DRD134951
R425	Same as R415	
R426	Same as R403	
R427	Same as R416	
R428	Same as R416	
R429	Res., 390, ±5%, ¼W, Carbon	DRD134731
R430	Res., 560, ±5%, ¼W, Carbon	DRD134771
R431	Res., 2.2k, ±5%, ¼W, Carbon	DRD134911
R432	Same as R424	
R433	Res., 220, ±5%, ¼W, Carbon	DRD134671
R434	Res., 1.5k, ±5%, ¼W, Carbon	DRD134871
R435	Res., 100, ±5%, ¼W, Carbon	DRD134591
R436	Same as R416	
R437	Same as R435	
R438	Same as R416	
R439	Res., 10, ±5%, ¼W, Carbon	DRD134351
R440	Res., 10k, ±5%, ¼W, Carbon	DRD135071
R441	Same as R440	
R442	Same as R416	
R444	Res., 470k, ±5%, ¼W, Carbon	DRD135471
R445	Same as R403	
R446	Same as R415	
R447	Same as R420	
R448	Same as R430	
R449	Res., B1k, Var., 0.5W, Metal	DRV430571
R450	Same as R440	
R451	Same as R440	
R452	Res., 33k, ±5%, ¼W, Carbon	DRD135191
R453	Same as R440	
R454	Res., 12k, ±5%, ¼W, Carbon	DRD135091
R455	Res., B2k, Var., 0.1W, Carbon, Ganged with R514 and S502	DRV147361
R456	Same as R433	
R457	Res., 2k, ±5%, ¼W, Carbon	DRD134901
R458	Same as R440	
R459	Res., 82, ±5%, ¼W, Carbon	DRD135291
R460	Same as R416	
R461	Same as R440	
R462	Same as R415	
R463	Res., B220, Var., 0.5W, Metal	DRV430551
R464	Same as R431	
R465	Res., 150, ±5%, ¼W, Carbon	DRD134631
R466	Res., 47k, ±5%, Carbon	DRD135231
R467	Same as R416	
R468	Same as R431	
R469	Same as R435	
R470	Res., 330k, ±5%, ¼W, Carbon	DRD134711
D401 to 403		
	Diode, 1S953	DDD010051
D404	Diode, 1K34A	DDD010101

CKT.NO.	DESCRIPTION	ECI PART NO.
D405 to 411	Same as D401	
Q401	Transistor, 2SC1815GR	DTR137781
Q402	FET, 2SK30A-Y	DTR210141
Q403 to 413	Same as Q401	
Q414	Transistor, 2SA1015Y	DTR116111
Q415	Same as Q401	
Q416	Same as Q401	
Q417	Same as Q414	
Q418	Same as Q402	
Q419	Same as Q401	
Q420	Same as Q414	
IC401	IC, SN74LS74AN	DIC140751
IC402	IC, CD4011BE	DIC410101
IC403	IC, SN74LS04N	DIC140051
J401	Connector, M33-M87-04	DCN034571
J402	Connector, BNC080	DCN040711
J403	Connector, M36-M87-02	DCN034601
	M31-C8-4	DCN034951
J404	Same as J403	
P401	Connector, M33-04-30-114P	DCN034661
P403	Connector, M36-02-30-114P	DCN034851
P404	Same as P403	
S401	Lever-switch, SLR343	DSW045031
S402	Lever-switch, SLR322	DSW045021
S404	Same as R402	
TB401	Terminal (CAL)	DTA010871

TIMING & HORIZONTAL AMPLIFIER

C501	Cap., 0.01μ, −20~+80%, 50V, Cer.	DCC133571
C502	Same as C501	
C503	Cap., 100p, ±5%, 50V, Cer.	DCC234001
C504	Cap., 1μ, −10~+100%, 50V, Elect.	DCE245021
C505	Cap., 0.033μ, ±10%, 50V, Film	DCF120291
C506	Cap., 3,300p, ±10%, 50V, Film	DCF120171
C507	Cap., 1μ, ±0.5%, 250V, Film	DCF260151
C508	Cap., 0.01μ, ±0.5%, 250, Film	DCF125771
C509	Cap., 82p±5%, 50V, Cer.	DCC246511
C510	Cap., 22.5p, Var., 250V, Cer.	DCV019711
C511	Same as C501	
C512	Cap., 22μ, −10~+100%, 25V, Elect.	DCE225151
C513	Cap., 1p, ±0.25p, 500V, Cer.	DCC250301
C514	Same as C513	
C515	Cap., 150p, ±5%, 50V, Cer.	DCC234201
C516	Same as C512	
R501	Res., 3.3k, ±5%, ¼W, Carbon	DRD134951
R502	Res., B10k, Var., 0.1W, Carbon	DRV147291
R503 to 505	Res., 1M, ±1%, ¼W, Metal	DRE139851
R506	Res., 600k, ±1%, ¼W, Metal	DRE139811
R507	Res., 200k, ±1%, ¼W, Metal	DRE131381
R508	Res., 100k, ±1%, ¼W, Metal	DRE131311
R509	Same as R508	
R510	Res., B470, Var., 0.5W, Metal	DRV430561
R511	Res., 2.2k, ±5%, ¼W, Carbon	DRD134911
R512	Same as R510	
R513	Same as R511	
R515	Res., 22k, ±5%, ¼W, Carbon	DRD135151
R516	Res., 33, ±5%, ¼W, Carbon	DRD134471
R517	Res., 3k, ±5%, ¼W, Carbon	DRD134941
R518	Res., 12k, ±5%, ¼W, Carbon	DRD135091
R519	Same as R511	
R520	Res., 10k, ±5%, ¼W, Carbon	DRD135071
R521	Res., 4.3k, ±5%, ¼W, Carbon	DRD134981
R522	Res., B1k, Var., 0.5W, Metal	DRV430571
R523	Same as R521	
R524	Res., B 100, Var., 0.5W, Metal	DRV430541
R525	Res., 680, ±5%, ¼W, Carbon	DRD134791
R526	Res., B220, Var., 0.5W, Metal	DRV430551
R527	Same as R501	
R528	Same as R520	
R529	Res., 47k, ±5%, ¼W, Carbon	DRD135231
R530	Same as R529	
R531	Res., 56k, ±5%, 1W, Metal	DRS220641

CKT.NO.	DESCRIPTION	ECI PART NO.
R532	Same as R529	
R533	Same as R529	
R534	Same as R531	
R535	Same as R517	
R536	Same as R517	
R537	Res., 82k, ±5%, 1W, Metal	DRS22o661
R538	Same as R537	
R52	Res., 75, ±5%, ¼W, Carbon	DRD134561
D501 to 506		
	Diode, 1S953	DDD010051
D508	Same as D501	
D509	Same as D501	
D510	Z. Diode, RD5.6EB	DDD030571
D511	Same as D510	
Q501	Transistor, 2SA1015Y	DTR116111
Q502	Transistor, 2SC1815GR	DTR137781
Q503	Same as Q501	
Q504 to 507		
	Transistor, 2SC1514	DTR136961
J501	Terminal, WP22-1B	DCN033821
J502	Same as J501	
S501	Rotaly-switch, PS22BH (24) 3-5-19/RV	DSW034571

Z AXIS AMPLIFIER & CRT CIRCUIT

C601	Cap., 100p, ±5%, 50V, Cer.	DCC234001
C602	Cap., 10p, ±0.5p, 50V, Cer.	DCC231701
C604	Cap., 0.01μ,±10%, 500V, Cer.	DCC153501
C605	Cap., 1μ, −10~ +100%, 25V, Elect.	DCE260251
C606	Cap., 0.01μ,−20~+80%, 3kV, Cer.	DCC173501
C607	Cap., 1,000p, ±10%, 500V, Cer.	DCC151811
C608	Cap., 1,000p, ±20%, 3kV, Cer.	DCC171831
C609 to C612		
	Same as C606	
C614	Cap., 3,300p, ±10%, 50V, Film	DCF120171
C615	Cap., 22μ, −10~+100%, 25V, Elect.	DCE225151
C616	Same as C615	
C617	Same as C608	
C618	Cap., 0.22μ, ±10%, 50V, Film	DCF120391
C619	Same as C604	
C620	Same as C604	
C621	Cap., 22p, ±5%, 50V, Cer.	DCC232401
R601	Res., 22k, ±5%, ¼W, Carbon	DRD135151
R602	Res., 4.7k, ±5%, ¼W, Carbon	DRD134991
R603	Same as R601	
R604	Res., B10k, Var., 0.1W, Carbon	DRV147331
R605	Res., 10k, ±5%, ¼W, Carbon	DRD135071
R606	Res., 3.9k, ±5%, ¼W, Carbon	DRD134971
R607	Res., 100k, ±5%, ¼W, Carbon	DRD135311
R608	Res., 56k, ±1%, ½W, Metal	DRE141251
R609	Res., 47k, ±5%, ¼W, Carbon	DRD135231
R610	Res., 82k, ±1%, ½W, Metal	DRE141291
R611	Same as R606	
R612	Res., 220, ±5%, ¼W, Carbon	DRD134671
R613	Res., 180, ±5%, 1W, Metal	DRS120341
R614	Res., B220k, Var., 0.5W, Metal	DRV430611
R615	Res., 82k, ±5%, ¼W, Carbon	DRD135291
R616	Same as R607	
R617	Same as R614	
R618	Same as R607	
R619	Res., 470k, ±5%, ¼W, Carbon	DRD135471
R620	Same as R605	
R621 to 624		
	Res., 5.1M, ±5%, ¼W, Carbon	DRD238721
R625	Res., 10, ±5%, ¼W, Carbon	DRD134351
R626	Res., 470, ±5%, ¼W, Carbon	DRD134751
R627	Res., 1k, ±5%, ¼W, Carbon	DRD134831
R268	Res., 1.5k, ±5%, ¼W, Carbon	DRD134871
R629	Same as R625	
R630	Same as R607	
R631	Res., 2.2k, ±5%, ¼W, Carbon	DRD134911
R632	Res., B47k, Var., 0.5W, Metal	DRV430601
R633	Res., 220k, ±5%, ¼W, Carbon	DRD135391
R639	Res., 16M, Var., 0.25W, Metal glaze film	DRG930111
R640	Res., 3M, ±5%, 1/3W, Carbon	DRD190131
R641	Res., B2M, Var., 1.0W, Metal	DRV350152
R642	Res., B10k, Var., 1.5W, Metal	DRV350161

CKT.NO.	DESCRIPTION	ECI PART NO.
R643	Res., 100k, ±5%, ¼W, Carbon	DRD135311
R644	Res., 10k, ±5%, ¼W, Carbon	DRD135071
D601	Diode, 1S953	DDD010051
D602	Z.Diode, RD5.1EB	DDD030571
D603	Diode, 1SS83	DDD010381
D605	Same as D601	
D606 to 608	Diode, ESJA35-12	DDD022111
D609	Diode, 1S1835	DDD990131
D610	Same as D609	
D611	Same as D606	
D612	Same as D601	
D613	Same as D601	
Q601	Transistor, 2SD668AC	DTR145381
Q602	Same as Q601	
Q603	Transistor, 2SC1061C	DTR130661
Q604	Transistor, 2SA1015Y	DTR116111
Q605	Transistor, 2SC1815GR	DTR137781
Q606	Same as Q601	
V601	CRT.150BTB31	DET012611
NE601	Neon-lamp, NE-68	DLP025051
NE602	Same as NE601	
L601	Trace rotation coil, FS-33656	DCL140311
T601	High-voltage transformer, HVT-3D4011	DCL220321
P601	Connector, M33-06-30-114P	DCN034681
P603	Connector, M33-05-30-114P	DCN034671
P604	Connector, M36-02-30-114P	DCN034851
P605	Same as P604	
P606	Same as P603	
P607	Connector, M33-03-30-114P	DCN034651

CKT.NO.	DESCRIPTION	ECI PART NO.
J601	Connector, M33・M87-06	DCN034591
J602	Connector, BNC080	DCN040711
J603	Connector, M33・M87-05	DCN034581
J604	Connector, M36・M87-02	DCN034601
J605	Same as J604	
J606	Same as J603	
J607	Connector, M33・M87-03	DCN034561
J608	CRT-socket, S-B0864	DSK010291
J609	Terminal, WP22-1B	DCN033821

POWER SUPPLY

C701	Cap., 33μ, −10 ~+100%, 100V, Elect.	DCE255081
C702	Cap., 47μ, −10~+100%, 250V, Elect.	DCE270651
C703	Same as C702	
C704	Cap., 4.7μ, −10~+100%, 250V, Elect.	DCE270401
C705	Cap., 2,200μ,−10~+100%, 25V, Elect.	DCE225231
C706	Same as C705	
C707	Cap., 0.01μ, −20~+80%, 50V, Cer.	DCC133571
C708	Cap., 22μ,−10~+100%, 25V, Elect.	DCE225151
C709	Same as C707	
C710	Same as C707	
C711	Cap., 100μ, −10~+100%, 25V, Elect.	DCE225181
C712	Same as C711	
C713	Same as C707	
C714	Cap., 0.01μ,±10%, 500V, Cer.	DCC153501
R701	Res., B50, Var., 1.5W, Metal	DRV350142
R702	Res., 100k, ±5%, ¼W, Carbon	DRD135311
R703	Res., 220k, ± 5%, ¼W, Carbon	DRD135391
R704	Res., 47k, ±5%, ¼W, Carbon	DRD135231
R705	Res., 2.4k, ±5%, 7W, Metal	DRS970121
R706	Res., 6.8, ±5%, ¼W, Carbon	DRD134311
R707	Same as R704	
R708	Res., 100, ±5%, ¼W, Carbon	DRD134591
R709	Same as R703	
R710	Res., 10k, ±5%, ¼W, Carbon	DRD135071
R712	Res., 2.2,±5%, ¼W, Carbon	DRD134191

CKT.NO.	DESCRIPTION	ECI PART NO.
R713	Res., 330, ±5%, ¼W, Carbon	DRD134711
R714	Res., 56k, ±5%, 1W, Metal	DRS120641
R715	Res., 1.2k, ±5%, ¼W, Carbon	DRD134851
R716	Same as R710	
R717	Res., B2.2k, Var., 0.5W, Metal	DRV430581
R718	Res., 6.8k, ±5%, ¼W, Carbon	DRD135031
R719	Res., 1k, ±5%, ¼W, Carbon	DRD134831
R720	Same as R712	
R721	Same as R710	
R722	Res., 20k, ±5%, ¼W, Carbon	DRD135141
R723	Same as R722	
R724	Res., 4.7k, ±5%, ¼W, Carbon	DRD134991
R725	Res., 470, ±5%, ¼W, Carbon	DRD134751
R726	Res., 4.3k, ±5%, ¼W, Carbon	DRD134981
R727	Res., 12k, ±5%, ¼W, Carbon	DRD135091
R728	Same as R704	
R729	Res., 240k, ±5%, ¼W, Carbon	DRD135401
R730	Res., 680, ±5%, ¼W, Carbon	DRD134791
D701	Diode, 1S953	DDD010051
D702	Same as D701	
D703	Z.Diode, RD5.1EB	DDD030571
D704	Same as D703	
D705	Same as D701	
D706	Diode, stack, 1G4B1 (Rectifying)	DDD021031
D707	Same as D706	
D708	Diode, stack, SIRBA10 (Rectifying)	DDD023271
D709	Same as D701	
Q701	Transistor, 2SC1505	DTR130921
Q702	Transistor, 2SC1514	DTR136961
Q703	Transistor, 2SC1815GR	DTR137781
Q704	Transistor, 2SD668AC	DTR145381
Q705	Transistor, 2SC1061C	DTR130661
Q706	Same as Q703	
Q707	Transistor, 2SA1015Y	DTR116111
Q708	Transistor, 2SB857C	DTR125231
Q709	Same as Q703	
Q710	Same as Q703	
IC701	IC, NJM4558D	DIC613031

CKT.NO.	DESCRIPTION	ECI PART NO.
T701	Power transformer, FS-33545	DCL212401
J702	Socket (Inlet), CM-3	DCN013361
J703	Socket, S-I 7220#04	DCN093521
J704	Connector, 128-09-10-281S	DCN032491
J705	Connector, M36・M87-02	DCN034601
	M31・C8-4	DCN034951
J706	Same as J705	
P703	Plug, X-I7213	DCN093511
P704	Connector, 128-09-10-281P	DCN032481
P705	Connector, M36-02-30-114P	DCN034851
P706	Same as P705	
F701	Fuse, FSA-0.5	DFU020131
	Fuse-holder, S-N1009	DSK060111
F702	Fuse, FSA-1	DFU020141
F703	Fuse, FA-0.2	DFU010131
PL701 to 703		
	Scale illumination lamp, BQ064-22011A	DLP016092
TB701	Terminal (GND), 8ϕ	DTA020501
S701	Push-switch, SDL1P	DSW014991

PRINTED CIRCUIT BOARD

PB101	Printed circuit board, V board	KPN177321
PB401	Printed circuit board, H board	KPN177421
PB601	Printed circuit board, CRT socket board	KPN177511

WARRANTY

ENERGY CONCEPTS, INCORPORATED, warrants this equipment to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of this unit which under normal installation, use, and service discloses such defect, provided that the unit is delivered by the purchaser to the leader from whom purchased, or to Energy Concepts, Incorporated, or to a stipulated agent, intact, for the purpose of examination within a period of two years from the date of sale to the original purchaser and provided such examination discloses in our judgment that it is defective.

This warranty does not apply if the equipment has been subjected to misuse, neglect, improper installation, used in violation of instructions provided by us, or if repaired or in any way altered outside of our factory or authorized service facility, or if the serial number has been removed, defaced or changed.

Any part approved for remedy or exchange hereunder will be remedied or exchanged without charge to the owner.

Energy Concepts, Inc., assumes no liability for injury, damage, or expense claimed to have been incurred through the use or in the installation of our equipment and products.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of this equipment.

Further information can be obtained from:
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